19·

Brighton and Hove Natural History and Philosophical Society.

ABSTRACTS OF PAPERS

READ BEFORE THE SOCIETY,

TOGETHER WITH THE

ANNUAL REPORT

FOR THE

YEAR ENDING JUNE 8TH, 1898.

Brighton:
THE SOUTHERN PUBLISHING COMPANY, LIMITED, 130, NORTH STREET.

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WEDNESDAY, OCTOBER 13TH, 1897.

INAUGURAL MEETING.

ADDRESS BY

PROF. G. S. BOULGER, F.L.S., F.G.S.

ON

THE VALUE OF FIELD WORK IN NATURAL HISTORY.

The ways in which field work is of value in the study of Natural History may be arranged and discussed as follows:—

1st.—As an incentive and introduction to the study of natural history.

2nd.—As providing necessary *material.*

3rd.—As the study of structural detail.

4th.—As the study of the life of the individual.

5th.—As the study of Hexicology.

1st.—It has been said that Gilbert White's *Natural History of Selborne* has made as many naturalists as Southey's *Life of Nelson* has made sailors.

The mind that is in no degree inquisitive can hardly be in any high degree intelligent; and the inquisitive mind whether of child or adult can hardly fail to find in any country walk material upon which to exercise itself. Professor Boulger described at some length the more noticeable phenomena which winter, spring, summer and autumn successively display to the dweller in the couutry. Continuing, he said that so valuable did he believe field work to be as an *incentive* that if any old established Natural History Society finds that it is falling off in numbers he should certainly recommend it to hold field meetings with informal *al fresco* lecturettes, and to try and get visitors as yet untouched by the enchantments of nature to attend such meetings. This would not only be the best means of

recruiting, but it will be at the same time the best introduction to the study of Natural History. The beginner is at once brought into contact with facts and not with mere brain-cobwebs of theory. He deprecated that *collecting,* which sometimes results in the pride of possessing some rare birds' eggs, rare plants or rare minerals—a taste which too often tends to the extermination of beautiful species among our flora and fauna. At the same time it must be said that every great naturalist, from Aristotle to Darwin, had been a collector, and if the young collector can be taught by the older members of a Field Club to observe scientifically and accurately, so as to learn how to identify species and the methods by which they are differentiated, instead of merely affixing a label to certain objects with the name inscribed on it, then collecting will become a scientific education.

2nd.—As to field work as a means of providing material for study, there was not much to be said. The Professor, however, emphasized the need of noting the manner in which the object collected is associated with others. A fragment of rock, for instance, may be analysed by the petrologist, but the knowledge of the mass of rock with which it is associated, or if an igneous one, with those with which it is brought into contact, will often be of service in determining the method of its genesis. Was it taken from the surface, from the sides where it was in contact with other rocks, or from the interior of the mass? If a fossil, there are many seemingly trivial details as to how and where it was obtained, which may be of the utmost value in determining its history.

3rd.—The study of structural detail. The chief feature which renders the late Professor Babington's *Manual* one of the most educational books to put into the hands of a student of Botany is, that so many little points of structural discrimination are brought out which are not recognisable in mere dried specimens. In the study of these difficult but interesting series of forms, for instance, the aquatic or 'Batrachian Ranunculi,' it is of great importance to note whether the segments of the submerged leaves when withdrawn from the water collapse or spread out, and the most recent German authorities on flowering plants insist strongly, in several parts of their system, on the hairs on the plant and the direction in which they grow, as a character of value.

4th.—The study of the life of the individual. Using the terms life and development in a wide sense, we may say that field work is of the very highest importance as a means of studying the life history of individuals in all their phases of

development. It is true we may cultivate fungi in our laboratories, or higher plants in our gardens and greenhouses: snakes will lay and hatch their eggs in captivity, and many animals can be most conveniently studied as they develop in our aquaria; but field work in many cases saves us all trouble; shows us various organisms growing, not in an artificially isolated, but in a natural condition, and shows us the life history of others which we should find it difficult to cultivate or domesticate.

5th.—Hexicology. Perhaps the most valuable of all the features of field work is that teaching of hexicology—natural environment—which it alone affords. To observe plants or animals living together in a natural state, struggling for existence, individual against individual, species against species, each more or less dependent upon others in that marvellous order which we term the "balance of nature," is to learn lessons in natural history which we cannot receive in the botanical or zoological garden, still less in the laboratory, museum, or library.

Symbiosis, or the mutual dependence of organisms, presents many problems to the observer of the very highest importance. There is the partial dependence of certain plants, such as our sundews and butterworts on some kind of animal life for their nitrogenous food, and there is also the more remarkable case of flowers, like some of our orchids, specially modified for the visits of certain special groups of insects, whilst the legs and other parts of insects are reciprocally adapted for the collection of honey or pollen from these special types of flowers.

Professor Boulger then proceeded to point out other directions in which additional field work is required. Those who live in the country may in the course of a series of years arrive at very precise and valuable results by observing the exact dates of the arrival of our migrant birds, of the hatching of new insect broods, of the unfolding of the leaves of the different kinds of trees, of the opening of particular species of flowers. He then proceeded to quote a passage from Sir A. Geikie's *Field Geology* emphasizing the opportunities which a ramble in the country affords for a study of the soil and the rocks, and pointing out what great problems may be solved by the intelligent observation of the common and familiar phenomena of nature, and went on to say: To these passages I will only add a few practical suggestions of my own. It is probable that Tilgate Forest or other parts of the not very distant Wealden area has still further reptilian spoils to yield to the worker who will follow in the footsteps of Mantell; whilst it is certain that much detailed work

remains to be done in unravelling the conditions under which both Wealden and Lower Greensand beds were formed in different parts of their outcrop. The last word has not been said either on the formation of flint and of flints, or on that of combes and pipes in the chalk or of your own Elephant Bed, and an immense amount of work is urgently needed on the zones of the chalk with special reference to the distribution of foraminifera throughout the series.

If I know of abundance of geological work still crying out for field-workers, I am aware of even more, I think, waiting to be done in Botany. The distribution of sea-weeds bathymetrically and geographically along our coast, and almost everything anent their methods of reproduction, await the attention alike of those who dredge, of those who confine their attention to the shore, and of the microscopists. Still more imperfect is our knowledge of the fresh-water algæ, whilst there is, I believe, nothing known at all as to their distribution in the various river drainage systems and estuaries of the county. Whilst algæ are readily preserved and furnish such beautiful herbaria that their study has long been graced by the many ladies who have been attracted by it, the study of fungi has, no doubt, suffered from the fact that they are mostly somewhat difficult to preserve, besides being often only too casual and transient in their occurrence. While, however, the smaller and microscopic forms, most of which are parasitic, the rusts, mildews and moulds, and that marvellous isolated group the Myxomycetes—about all of which our knowledge of species, of their life histories, and of their distribution, is most imperfect —afford material for the microscopist, and more especially for the micro-photographer, or the draughtsman with the *camera lucida*; there are methods of preserving the larger forms, such as that described by the late James English: water colour drawings by competent artists are often capable of being specifically identified; and even a "nature-print" of the gills, traced in their own spores, which any one can take with a little gum and some black blotting paper, may be a valuable record. There is no more enjoyable a form of autumnal natural history ramble than a fungus foray, whether followed by experiments on the esculent qualities of the group as adjuncts to more substantial viands, or not. Few who have not collected are aware of the wide range of colour and beauty of outline presented by the numerous species: it is only in a very few long-worked localities such as Epping Forest and the neighbourhood of Hereford that we have anything like a knowledge of the variety of species that may occur; and even in these areas several species new to science, or at least new to

Britain, are yearly added to the list. With such works as Stephenson's *Fungus-Flora* for the higher and Massee's for the lower forms, Dr. Cooke's works, Mr. Worthington Smith's sheets illustrative of the edible and poisonous kinds or with the little guides to the Sowerby Models or to the Myxomycetes in the Natural History Museum, it is not difficult for anyone with ordinary botanical training to identify most of his finds.

Unlike the collectors in most other classes we need not be trammelled, I think, with any fear of exterminating rare species; and assuredly there are plenty of problems as to life history, influence of weather, chemistry of colour and of alkaloids, and physiological action, awaiting the researches of those who contemn mere species hunting. If the members of our various field clubs would only work out the distribution of the fungi of their own immediate districts, noting their manner of occurrence, as to soil, shade, weather, food, etc., this is just one of the subjects in which most valuable results could be obtained over a wide area, by the communication of local lists, confirmed, where possible, by verified specimens, to the central mycological research committee of a union of Societies.

Sussex, since the days of William Borrer of Henfield, has had a fair share of resident critical botanists, and the long residence of Mr. Mitten at Hurstpierpoint will not, perhaps, have left many novelties to be gleamed among mosses and their allies; nor are the dry soils and climate of south-eastern England favourable to fern life; whilst it is among the more conspicuous flowering plants that most observations have been made in this, as in all other districts. Nevertheless, though the work of the late Mr. Roper was fairly complete for the Eastbourne district, there is still much to be done for the county generally, and, I think, for this immediate district, even in phanerogamic botany. The question how far the distribution of species is determined by the chemical character, as apart from the moisture of the soil, and how for it follows watersheds in a comparatively low lying area such as this, is by no means completely answered as yet, nor, perhaps, are we likely to get much reply to it of a satisfactory character, until the more critical genera, such as brambles and roses, have been carefully worked. Here, too, again, in addition to those distributional phenomena which in my opinion form the special province of field clubs, there is at least as great a variety of problems concerning development, comparative anatomy and physiology awaiting solution or further elucidation as in any other division of the vegetable kingdom. Many flowering plants are partly parasitic or saprophytic, or are accompanied with that

mycorhyza to which I have already referred. Abnormalities constantly occur in a wild state, and still more in our gardens, which may throw important light upon structure, and often in this way suggest modifications in our classifications. Besides those familiar physiological topics that were illuminated by the work of the last years of Charles Darwin, climbing, carnivorousness, and the wide field of pollination, with the subsidiary subject of hybridism, there is the most important series of questions as to how far certain cases of apparently parallel development among plants living under similar conditions are indicative of real affinity, or community of descent, or how far they are merely adaptational, how far they may be directly produced by the stimuli of external conditions, or how far, if so acquired, their characters can be hereditarily transmitted. To this question, which lies at the very root of the controversy between Weismann and the Neo-Lamarckians, it seems rather as if at present botanists were disposed to give an opposite reply to that of most zoologists.

There are many groups of animals, such as earth worms and spiders, and I may, perhaps, add marine worms, leeches and crabs, which have only one or two men in the whole kingdom devoted to their study, and which yet are handy enough for any of us to study, and would throw as much light upon the fundamental problems of biology as any of the more popular groups. Our land and fresh water mollusca present interesting questions as to distribution with reference to soil and the hardness of the water.

Passing on to the Arthropoda, Huxley's *Crayfish*, Miall's *Cockroach* and Lowne's *Blowfly*, together with such works as those of Lubbock and Packard seem to specially invite us to a detailed study of comparative anatomy and developement, whilst the complex symbiotic conditions of bees, ants, ichneumons and gall flies equally attract us in the direction of pure observational study of the life histories of living insects. There is plenty to be done in the intelligent collecting and study of the micro-lepidoptera, and, even among the too commonly collected macro-lepidoptera, such ubiquitously abundant species of the cabbage-whites and the common blue present most interesting series of variations in size and marking, which seem, at least in the latter case, to be connected with geographical range. Other groups, such as the Diptera, Hymenoptera and Coleoptera, have as yet few workers devoted to them in any district; and, whether in the discovery of new species, the working out the distribution of those already known, the tracing of food-plants, or other points in the life history, offer abundant promise of valuable results.

There are, I believe, few field clubs in whose Transactions can be found even a list either of the dragon flies, or of the grasshoppers of the district. Coming to vertebrate animals, I would suggest that something is wanting to our knowledge of the life history of our smaller fresh water and marine fishes.

Birds, like butterflies, have many collectors; but here, too, there is room for a more scientific basis for observations. The beautiful cases in the Natural History Museum, South Kensington, suggest the many questions of variations in a wild state, seasonal variation in plumage, sexual divergence in successive moultings, and protective resemblance of eggs or of plumage, and the recent application of the telescopic camera to this purpose by the Messrs. Kearton and others, shows us a new and valuable means at our disposal for the observation of nesting and other habits.

In conclusion, I wish to say a few words as to the conditions which are essential to the value of all field work, and how they can best be maintained. The conditions are briefly, accuracy and system. In all recorded facts in natural history it is primarily essential that there shall be as little doubt as possible as to the species concerning which the facts are recorded. In that compilation, therefore, of local lists, which is the peculiar work of Field Clubs—work in which many members should co-operate—it is most desirable that specimens should be preserved in a local museum, and that, before publication, any groups in the least degree critical should be referred to a competent specialist. It is, be it remembered, only when observations are multiplied that we can obtain those statistical averages which are of so much higher value than merely isolated observations, and an average generally increases in value in proportion to the number of items from which it is drawn.

Among the differences of condition under which it is desirable that our observations should be made, those of position are, I think, of the highest importance to local field naturalists. Be it merely records of the thermometer, barometer and rain gauge, or the occurrence of a plant or animal, the questions of altitude above sea level, distance from the sea, direction of exposure, nature of soil or of surrounding vegetation, and relation to river drainage systems may be of the highest importance. To eliminate merely seasonal fluctuations, or those which are produced by the total differences of climate in one year compared with another, it is necessary that most of our observations should be continuous or repeated from time to time. Thus, for instance, we may become aware of secular changes in the level of land and

water, or in climate; and thus the deplorable extinction of our flora and fauna, by agriculture, drainage, building and over-collecting, may be traced from year to year.

Accuracy and system, then, are the two characteristics which distinguish scientific from ordinary knowledge.

But it is desirable also that the results we have ourselves obtained should be compared with the observations of others. Hence the necessity for conferences between the Secretaries of Societies such as this, so that schedules of questions to be answered may be prepared, and forms drawn up for the tabulation of results, and opportunities be afforded for the discussion of methods and research. Hence the advantage by these Unions of Natural History Societies, under a limited number of which I hope soon to see ranked all the Field Clubs of the land.

MONDAY, NOVEMBER 15TH.

AT THE LECTURE HALL OF THE Y.M.C.A., 55, OLD STEINE.

BACTERIA IN RELATION TO HEALTH AND DISEASE.

ILLUSTRATED BY LANTERN SLIDES OF THE MORE IMPORTANT MICROBES,

including those concerned in important Processes of Nature, in Trades and Manufactures, and in the Production of such Diseases as Typhoid Fever, Diphtheria, Tuberculosis, Tetanus, &c.

BY

DR. ARTHUR NEWSHOLME

(Medical Officer of Health for Brighton).

THURSDAY, DECEMBER 10TH, 1897.

THE ROSEN COLLECTION OF HORNS IN THE BRIGHTON MUSEUM.

BY

MR. B. LOMAX, F.L.S

WEDNESDAY, JANUARY 12TH, 1898.

1897.—A SCIENTIFIC RETROSPECT.

BY

MR. EDWARD ALLOWAY PANKHURST.

THURSDAY, FEBRUARY 10TH, 1898.

(IN THE ART ROOM, MUNICIPAL SCHOOL OF ART.)

SOME POLYZOA OF THE COAST

(ILLUSTRATED BY LANTERN SLIDES).

BY

DR. H. S. GABBETT (OF EASTBOURNE).

The paper, which was illustrated by a number of photo-micrographs shown by the lantern, described the characteristics and affinities of Polyzoa in general, and gave a detailed account of the structure of the following species, common on the coast of the neighbourhood: — *Crisia Eburnea, Diastopora Patina, Idmonea Serpens, Flustrella Hispida, Membranipora Pilosa, M. Lacroixii, Flustra Foliacea, F. Papyracea, Cellaria Fistulosa, Cellepora Pumicosa, Mucronella Coccinea, Microporella Ciliata, Scrupocellaria Scruposa, Bugula Flabellata, Bicellaria Ciliata.*

Special attention was directed to the appendages of the Polyzoan colony,—spines, vibracula, "birds'-head bodies," and oœcia; and many photographic illustrations were exhibited. The paper concluded with a brief account of the minute structure and functions of the tentacles, alimentary canal, and muscular system; and photomicrographs were shown, representing various diatoms which form a large part of the food of polyzoa, and which are constantly found in the stomachs of these animals.

THURSDAY, MARCH 10th, 1898.

(In the Art Room, Municipal School of Art.)

ANCIENT EGYPT.

BY

Mr. W. CLARKSON WALLIS.

The lecture was illustrated by lantern slides, and also by a large collection of objects obtained in Egypt by Mr. Wallis.

Ancient Egypt is a land of special interest to us, not only from the familiarity we had with it from our earliest days by means of the Scriptures, but also by the completeness with which we were able to realise the history of the life of those far-off ages. So wonderfully had the climate and soil of that country assisted in the preservation of records, that nowadays we were able to picture for ourselves all the varied features of a civilization that had long passed away. For the present age, it was a land of expectations; we never knew what we were going to discover next. Fragments of Homer and of sacred literature had been found, and, for all that we knew, surprises of an extraordinary and deeply interesting nature might be in store. There was no reason why explorers should not come upon some ancient copy of the Scriptures that would do much to settle troublesomo controversies. Talking about the geography and geology of Egypt, Mr. Wallis said that it was essentially the land of the Nile. That wonderful river was, indeed, the "river of the water of life;" it was Hapi, "the father of gods, Lord of sustenance who giveth life, who banisheth want and filleth the granaries." The early history of Egypt went back many thousands of years, far beyond what had generally been accepted as the limits of historic time. The early inhabitants were lost in the mists of a prehistoric period. In historic times they found a mixed race in the land. The monuments proved that there were four distinct types,—the negro, the Lybian, the Asiatic, and the Punite, which last developed into the dynastic race. Mr. Wallis made reference to the peculiar race also found in Egypt, who, so far from mummifying their dead and preserving the bodies with scrupulous care, actually devoured the flesh, not for food, but as a special mark of honour. Passing over the mythical period of

Egyptian history and its fantastic legends of gods and demigods, Mr. Wallis mentioned the first king of whom we had any definite knowledge as Menes, the founder of Memphis, whose date was about 4,800 B.C. Khufu, the builder of the great Pyramid, came in the fourth dynasty, a thousand years later. It was in this dynasty, so far removed from the present day, that the arts of Egypt reached their highest point. Subsequently they were never surpassed in grandeur, simplicity, and power. In the fifth dynasty was found a singularly high level of understanding, as evinced by the precepts of Ptah-hotep, which revealed a high perception in abstract thinking and morality. Fifteen hundred years passed, and the rule in Egypt was usurped by the Hyksos invaders, or "shepherd kings," of whom very little was known, and who were probably the kings visited by the Hebrew patriarchs. Egypt reached its summit of glory as a power in the world in the reigns of Thothmes I. and Thothmes III., who carried their armies victoriously to the Euphrates, and far into Asia, who built the mighty temples that even now are the wonder of the world, and under whom the country attained its greatest wealth and prosperity. Later on came the stirring periods of Rameses I., Seti I., and Rameses II. Mr. Wallis spoke of the famous campaign of Rameses II. against the Hittites, of which a particularly graphic account was written by the Poet Laureate of the day, Pentaur. According to this, the oldest epic poem in the world, Rameses rallied his disheartened armies, dashed single-handed into the hosts of the Hittites,—evidently no mean adversaries,—and aided by his god Amen, slew them in thousands. The result of the battle was a treaty, still preserved, which was the first diplomatic document known to history.

Turning to the religion of the Egyptians, Mr. Wallis described it as difficult to form any definite idea upon it, owing to the vast mass of material. Whilst there were certain great leading features that remained unchanged from the earliest times, the religion as a whole was an accretion, the component parts of which were derived from many sources and during long periods of time. These additions often bore no relation to each other, and, therefore, involved the most extraordinary contradictions and discrepancies. Deities which were universally worshipped held positions widely different in importance in different localities, and in fact, frequently were varied essentially in their attributes. In, later times, particularly in the Ptolemaic period, attempts were made to systematise the confused combinations by sorting them into trinities, a process that subsequently led up to the idea of

the unity of all the gods. Professor Maspero and Professor Petrie held that the Egyptian idea of the Deity had nothing in common with our modern monotheism. This assertion seemed somewhat difficult to reconcile with the expressions that occurred in many of the hymns, even of the earliest times. In texts of the fifth century many expressions occur which ascribe attributes to the Deity which entirely distinguish him from the lesser gods. In later dynasties the attributes of the sole God became associated with the god Amen, and though it was true that Amen was originally only a local god, yet it was not impossible to believe that the idea of the Neter gradually centred itself into a name. The sun was his symbol, and his cognomen became compounded as Amen-Ra. To prove that he was not regarded as a material sun, Mr. Wallis quoted from the Egyptian "Book of the Dead," and he made reference to the same remarkable work in demonstrating other arguments. From the attributes of this god set forth in such texts, Dr. Brugsch and others had come to the conclusion that the dwellers in the Nile valley from the earliest times knew and worshipped one God, nameless, incomprehensible, and eternal. If words meant anything, it was clear that the Egyptian priesthood (if not the laity) held abstract ideas of the Divine Being, and that, whether or not he was known by different names in different cities, the conception was of a God who was one "besides whom there is no other." That expression actually occurred in a hymn. Amongst the smaller gods were Nu, the representation of the primeval watery waste; Nut, the female principle of Nu, and who was the heavens; Ptah, the creative principle; Khepera, a form of the rising sun which was both a type of matter which is on the point of passing from inertness into life, and of the dead body which was about to burst forth into a new life in a glorified form. The God was typified by a beetle, or scarabæus, and thus it was that scarabæi were found so numerously in tombs. The lecturer also gave the legends concerning Osiris, the God of the underworld, the Lord of Eternity, the Judge of the Dead, and the type of what the dead hoped to become, telling how the evil principle (Set) dismembered him, how Isis recovered the lost fragments, and brought Osiris to life again. Osiris appeared as the good principle at war with the evil, and, through his sufferings, he became the victor and the saviour of mankind.

Regarding the ideas of the Egyptians concerning themselves, Mr. Wallis pointed out that they considered each human being as comprising three portions; there was the body, which was

liable to decay, but which, believing that it would be wanted some day, they took such care to preserve; then there was the spiritual body, which was lasting and incorruptible; and thirdly, there was the heart, which was the seat of the power of life, and the fountain of good and evil thoughts. Besides these somewhat corporeal elements were others less tangible. There was the myterious Ka, or double, supposed to be the vital principle. It was believed that it could not exist by itself, and hence were made the statuettes found so numerously in tombs. The idea was a curious one, namely, that the Ka stretched itself around these images, which were made like the dead person, in the same way that a glove fits to the hand. The Ka did not stay always in the tomb, but had the power of going out, through a mock door painted or carved in the wall. A significance was also given to the soul; to the shadow; to the Khu, or intelligence, or "the shining," a kind of halo that was supposed to emanate from the person; to the form; and even to the name. As to the future of the soul, the "Book of the Dead," some of which went back in age to the first dynasty, gave long details of the passage through the dim regions of the dead, guarded with animal-headed deities, the dread ordeals, the weighing in the balances, and the final judgment. For the good soul, it was promised that it should exist for "millions and millions of years," "in heaven by the side of God in the most holy place," and texts were found such as "My soul is God, my soul is eternity," or "Soul to heaven, body to earth." In conclusion, Mr. Wallis said that Egypt had had the greatest of influence upon the world; an influence that, in many channels, had come down to us, and remained with us at the present day.

THURSDAY, MARCH 24TH.

LECTURE IN THE DOME

BY

MR. F. COURTENEY SELOUS,

ON

TRAVEL AND ADVENTURE IN SOUTH AFRICA

(WITH LANTERN ILLUSTRATIONS).

This lecture, it was explained by Mr. J. P. Slingsby Roberts, in introducing Mr. Selous, was one of a series by which

the Society aims at extending its influence beyond its immediate membership. It was the first time in the history of the Society in which they had ever met in the Dome. As for the subject of the inaugural lecture, he thought nothing could be more appropriate, for the eyes of the world were at present to a great extent fixed on South Africa. He referred to Mr. Selous as one of the most able and energetic of those pioneers who, in distant lands had "scorned delights and lived laborious days" in order to make England great.

Mr. Selous had an enthusiastic reception on rising to relate, as he put it, a few of his experiences in hunting in the interior of Africa. Speaking in an easy conversational manner, he described the state of things existing in South Africa in 1871, when he first landed there, and attributed the vast progress since made to the far-seeing statesmanship and splendid enterprise of Mr. Cecil Rhodes. There was then only one short line of railway between Cape Town and a neighbouring village in the whole of South Africa, and his journey from the coast to the diamond fields in a bullock van took him two months. His object, he explained, was not to seek diamonds, but to get into the interior, where he hoped to find wild game in abundance, be unhindered by fences or rails, and see no objectionable notice boards intimating that trespassers would be prosecuted.

Hunting Adventures.

He entered Matabeleland in August, 1872, and obtained permission to hunt elephants from Lobengula. In 1874 he visited the Victoria Falls on the Zambesi, and in 1877 crossed the Zambesi, and penetrated far into the country beyond. He travelled for months together without seeing a white man. For three years, he said, he saw no newspaper, or telegram, or any kind of money; and what was more singular, he was perfectly happy without any of these things. He travelled and shot, and with the ivory purchased whatever was necessary for himself and the natives who accompanied him in his expeditions. The greater part of Mr. Selous's lecture, however, was taken up with a description of an adventure in the remote interior, when his camp was raided at night, and he was put in great peril by the treachery of the natives. He escaped with his rifle and only four cartridges, but lost his weapon the following day by a further act of treachery on the part of the natives he had thought friendly, and had to wander alone 200 miles through the bush, making the best of his way by night, and hiding by day, till he met the remnant of his party in the Zambesi Valley. Of the twenty-

three with him in the camp, twelve were missing, and five wounded. During the latter part of the evening, Mr. Selous exhibited on a large screen a number of limelight views, illustrating incidents of his hunting expeditions. In most of these, lions played a prominent part, but one picture showed the hunter in great peril from an elephant, and in another he was seen almost slaughtered by a savage buffalo. There were also some views of African scenery, the most remarkable being a series of pictures of the Victoria Falls, and some pictures reminiscent of the Matabele campaign.

WEDNESDAY, APRIL 13TH.

PARASITISM

(WITH LANTERN ILLUSTRATIONS).

BY

MR. D. E. CAUSH, L.D.S.

Many, perhaps most, animals, even some of the smallest, take in lodgers and boarders. This fact in natural history is prettily summarised in a familiar couplet :—

"Big fleas have little fleas upon their backs to bite 'em,
Little fleas have lesser fleas and so *ad infinitum.*"

Mr. Caush said that these companionships were so general both in the animal and vegetable world that the difficulty was to know where to start in talking about them. If size were made the test, then in the vegetable world they had parasites varying in size from the minute bacteria on which Dr. Newsholme discoursed so ably before the Society a short time since, of which it would require some millions to cover a square inch if laid side by side, to the tropical parasitical plant whose flower will measure from two to three feet across when expanded ; or we may form some idea of their size by examining the giant trees of the tropical forest killed by the ever-twining stems of these parasitical plants. If they confined themselves to those living upon insects or animals, they had a range from the infinitely small to those five or six feet long human parasites, who live upon their fellow men, by begging, borrowing, or by their specious "Spider and Fly" like advertisements of "Money to Lend," &c. It was not, however, of this

latter class, the worst of all parasites, that he proposed to speak. Nor could colour be taken as a test of classification, as the colours were as varied as the colours of the rainbow. Nor could the defining line be that of usefulness or otherwise; for, before they had travelled far, they would founder on some all-important but hidden rock. He proposed to confine himself by the aid of photomicrographs to some of the better-known varieties of parasitic insects. The first division had been aptly termed "lodgers." The lodgers make use of their host as a dwelling-place, sometimes using the host for a short time only, and then vacating the establishment for one more suited to their requirements. Amongst this large group may be found the barnacles attached to the skin of the whale; or the sea anemone, who frequently prefers the shell of the hermit crab, or shells of similar character, to that of a more solid basis, so that its diet may be varied by its being carried to pastures ever new. Again, we have a very large number of sponges, as well as a number of tube worms, who attach themselves to inhabited shells of various kinds. In this latter case we may look upon the tube worms as permanent lodgers, as, prior to building their establishment, they make the foundations very firm upon the surface of the shells they intend to reside upon. Many also of the polyzoa are to be found amongst this class, as was well illustrated by Dr. Gabbett in his interesting lecture lately delivered before this Society; whilst, if time would permit, a very great variety may be enumerated as living under similar circumstances, examples of which may be found upon our beach with each receding tide, or in the pools amongst the rocks at low water. The second group were not only "lodgers," but also "boarders" in the truest sense of the word, expecting their host not only to supply apartments, but also a liberal table. These all breathe oxygen, and it may be interesting here to see the wonderful provision of the Great Creator in their elaborate breathing apparatus. Though they have mouths and many of them are provided with powerful lancets and marvellous pieces of apparatus for the purpose of feeding, they do not use their mouths for breathing purposes. In the insects themselves there are no true lungs, but wonderful pieces of apparatus whereby the air is circulated over the body. Thus we find scattered all over the body a number of minute openings, frequently covered by fine hairs, which have the power of moving so as to prevent any objectionable substance passing into the openings. These openings are known as spiracles and are the true breathing pores of the insect. On dissecting one of these we find connected with

these spiracles a large number of perfect spiral tubes composed of elastic tissue, and passing into and all over the body of the insect, branching and radiating so that the air may be conveyed to every part; to these the name of tracheœ have been given. We also find that most of them pass through four stages: The egg; the larvæ; the pupæ; and, lastly, the perfect insect.

Mr. Caush then went on to exhibit a number of slides of aphides, acari, pediculus, and pulex. As the views were shown Mr. Caush commented upon the structure and habits of the different classes of parasites shown. Some startling details were given as to the rate of multiplication. For example, the pediculus develops from the egg in five or six days very much like the adult, and in eighteen days they are able to reproduce their kind. Thus in two months two females with their offspring can produce the small family of ten thousand.

WEDNESDAY, MAY 11TH.

(KING'S APARTMENTS, ROYAL PAVILION.)

PROTECTIVE MIMICRY AS EXHIBITED IN MAMMALS.

BY

DR. LOUIS ROBINSON,

Author of "Wild Traits in Tame Animals."

At the outset let us consider what is meant by Protective Mimicry. All of us who have paid any attention to natural objects in our walks in the country must have noticed how remarkably many insects and other creatures resemble their natural surroundings. It is by no means easy to see a grasshopper among the grass, or a green caterpillar in the cabbages. In the tropics many and marvellous instances are found of creatures which exactly resemble dead leaves, bits of stick, lumps of lichen or moss, or even worm castings and the droppings of birds. If these are instances of protective mimicry, no question conld arise as to the prevalence of protective mimicry among the mammalia, for we find plenty of instances of warm blooded four-footed beasts resembling their environment.

One of the most striking of these, perhaps, is that of a species of sloth which hangs and browses upon the trees in Central and Southern America. These trees are festooned with great masses of pendant moss which cling closely round branches and stumps of branches coming out from the larger trunks. Some naturalists remarked that although these sloths are of the same green colour as certain masses of tree moss, they appear to be rendered conspicuous by a large brown mark upon the back. This, however, is only when the sloth is removed from its natural environment, for it is found that when they are at home upon the trees, the brown patch upon the back gives an almost exact imitation of a stump of a broken branch.

Our common ground animals, such as rabbits, weasels, and field mice, are usually of the same neutral colour as the half dry grass and leaves among which they hide themselves. The dappled skins of fallow deer so exactly resemble the appearance of light falling through a chequered curtain of leaves upon the ground, that it is often difficult to observe them. The stripes on the tiger so resemble the grass and the shadows between of the tropical jungle, that even the most experienced eyes are constantly deceived. Spotted leopards and tiger cats which inhabit the woods may hide with impunity among foliage where any large animal of uniform colour would be rendered conspicuous.

But all this is not protective mimicry in the sense in which the term is used by naturalists. We speak of such cases as instances of protective resemblance, and I wish to draw, at the outset, a clear distinction between this and protective mimicry, because the origin of the two methods of obtaining protection from enemies are radically different. The term protective mimicry is only applicable when applied to instances in which one living creature so strikingly resembles another of a different species as to be readily mistaken for it. Protective mimicry differs from protective resemblance to surroundings in that it is based upon the desire to be conspicuous, and not upon the desire to be inconspicuous. Now, let me say before I go further that, in using words and phrases such as "mimicry," "desire to be inconspicuous," and so on, the naturalist does not mean that these humble fellow creatures of ours make any endeavour, either conscious or unconscious, to be like their neighbours. It would be perfectly futile if they did. If we rational folk by taking thought cannot add one cubit to our stature, still less is it likely that a butterfly could voluntarily make itself like a wasp, or a spider like an ant or a beetle. The phenomena with which we are dealing are merely the outcome of natural

laws, and the living organisms are merely the counters in Nature's great game. We find it difficult, however, to avoid using terms which seem to imply intention and design both on the side of the moulding forces and the creatures subjected thereto.

In order to understand protective mimicry aright, you must first pay attention to what naturalists speak of as warning colouration. A long time ago it excited surprise among students of nature that some of the very feeblest of living beings, instead of hiding away from their enemies, in accordance with the general rule, flaunt their conspicuous colours abroad in the most barefaced and reckless manner. When Darwin was studying the colours of animals, he at one time was in danger of being led away by enthusiasm for one of his pet theories. This was the theory of sexual selection. He found that many birds put on gay plumage in the spring, and that male and female butterflies seemed to seek one another because of their brilliant colours. But at the time when he was inclined to attribute most bright colours found among animals to the needs of courtship, he was somewhat taken aback on finding that certain caterpillars, who resemble angels in one particular, in that they do not marry or are given in marriage, were in the habit of wearing very marked and conspicuous attire. He wrote to his great coadjutor, Alfred Russell Wallace, about the subject, and got the reply that in all probability it would be found that birds refuse to eat conspicuous larvæ because they have some nauseous taste or smell, or some other property which renders them unfit for food. I must quote you a few words of Darwin's reply to Wallace's communication. He wrote:—"You are the man to refer to in a difficulty. I never heard anything more ingenious than your suggestion, and I hope you may be able to prove it true. That is a splendid fact about the white moths, and it warms one's very blood to see a theory thus almost proved to be true" Now Wallace, in conjunction with his other great colleague, Henry Walter Bates, did prove this theory to be true; and it is a striking illustration of how one discovery in science often at once leads to other discoveries even more brilliant, that from these observations sprang our knowledge of the marvellous facts of protective mimicry. We now know, without need of experiment, that a weak and conspicuous animal which makes no attempt to hide itself, is almost certainly inedible to the birds, lizards, etc., which are in the habit of preying upon insects. There are certain striking exceptions to this rule, and as these exceptions form the very subject of this paper, we must by no means ignore them.

These exceptions are the creatures which have so mimicked

their nauseous and conspicuous neighbours as to be mistaken for them by insectivorous foes. I am not enough of an entomologist to be able to pronounce with confidence some of the imposing Latin names of the butterflies mentioned in works dealing with protective mimicry. Let it suffice, then, to say that Bates discovered in Northern Brazil several kinds of conspicuous butterflies which were so much alike as to deceive even a skilled entomologist, yet which were found upon close examination to be in no way related. Bates found that it was only their conspicuous parts which had become altered so as to produce resemblance. In their hidden and internal parts they each conformed to the structure of their own proper section of the insect world. Further investigation proved that wherever such likenesses existed, one species was usually more numerous than others, and moreover possessed certain qualities which rendered them unfit for food, and fairly secure from attack. . . . I have said that these conspicuous, and at the same time nauseous, and otherwise formidable creatures profit by their bold advertisement. It is not difficult to see where the gain comes in. We are all acquainted with the proverbs. "Once bit, twice shy," and "A burnt child fears the fire." Now a bird which had once had a painful experience in trying to eat one of these acrid insects would hesitate about attacking another exactly like it. The insects, if one may so speak, make themselves as disgusting as possible and proclaim the fact they are intolerably nasty by every means in their power.

In studying the subject of mimicry it has been found necessary to divide it into two sections. One deals with protective mimicry in which insects and other animals, themselves edible, gain immunity from attack by resembling those which are nauseous; the other with aggressive mimicry, when the semblance of another creature is adopted, not for the sake of eacaping enemies but for the sake of preying upon the victims of deceit.

To this latter class belong certain flies which almost exactly resemble humble bees, and which steal into the nests of the latter and lay their eggs in the bees' nursery, so that the larval flies, when hatched, commence to dine upon the young bees without going far in search of their food. Another instance, to which attention was drawn by Mr. and Mrs. Packham, the American naturalists, to whom we owe the distinction between protective and aggressive mimicry, is that of a spider which assumes the exact shape of an ant, so that he may prey upon the small beetle, which is one of the ant's domestic animals.

You may search all the museums and nearly all the books in the world and you will find that scarcely a single instance has been brought forward, even by way of suggestion, of protective mimicry among mammals. The one case quoted in Beddard's book on Animal Colouration is that of a tree shrew which inhabits certain of the East Indian Isles, and which has a very close resemblance to a black squirrel of about the same size, plentiful in the same regions. In the Natural History Museum of South Kensington you will find the two animals mounted side by side, and certainly the resemblance is very close. Moreover, the shrews are an eccentric and versatile race, and would, therefore, be more likely to exhibit protective mimicry than many other families of mammals. It appears probable that this is an instance of aggressive rather than protective mimicry, for squirrels are as a rule vegetarians, and, therefore, their presence would not alarm the insects and other small deer which inhabit the branches when they are constantly passing to and fro.

Now let us consider for a moment why it is that protective mimicry is not more common among the comparatively highly organised mammalia. There are, I think, three principal reasons.

One is that the mammalia are comparatively very much more modern than the more lowly organised insect population, and therefore possibly they have not had time to evolve such elaborate artifices to escape from their foes.

Secondly, that the danger which most mammals have to guard against is of a very different character from that which threatened the butterflies and other insects. The latter are preyed upon almost exclusively by insectivorous birds and reptiles. One might say, indeed, that nearly all the shifts resorted to by lepidopterous mimics are expressly for the sake of deceiving the eyes of birds. Now mammals are probably more preyed upon by their fellow mammals than by any other destructive agent, and these warm-blooded enemies seldom, like the birds, trust to a single sense, namely, that of sight in detecting and securing prey.

Nearly all the mammalians have an elaborate olfactory apparatus and ears, which not only hear the slightest sound, but, owing to the movable external ear trumpet, worn by nearly all mammals, are able to detect the direction from which it comes. Moreover, generally speaking, mammals are more intelligent than birds or reptiles, and can draw better conclusions from the evidence of their senses. It would be of little use for a hare, escaping from a pack of hounds, to resemble some creature which dogs hold in abhorrence; nor would a field mouse, whose

movements among the rustling dry grass, betray its whereabouts to a cat, gain much by mimicing some creature ignored or dreaded by all felines.

The third reason why protective mimicry is comparatively rare among mammals, is because warning colourations are distinctly rare among the higher animals; and we have seen that most cases of protective mimicry are founded upon definite warning colouration. It is true, there exist one or two marked cases of animals which exhibit warning colours. The skunk, as pointed out by Wallace, and also by Belt, the brilliant author of the *Naturalist in Nicaragua*, is a very conspicuous object when among his natural surroundings, and usually makes no effort whatever to get out of the way. But as an example of mimicry, the skunk is as one crying in the wilderness, "born to blush unseen, and waste his sweetness on the desert air." A few other animals, such as the gorilla and certain squirrels, seem also to display warning colouration, but I am not aware that in a single case has the hint been taken by any feeble creature.

Are we, then, to confess that mimicry is practically unknown among mammals? and must I sum up my paper in a manner similar to the Irish naturalist historian, who devoted a separate chapter to snakes, consisting merely of the words, "There are no snakes in Ireland"?

Personally, I do not think so; and I am about to submit to you several cases which, I think, cannot otherwise be regarded than as instances of protective mimicry. The books which deal with protective mimicry not only confine their attention almost exclusively to insects, amphibia, and reptiles, but seem to deal as exclusively with resemblances calculated to deceive the eye. Most of the cases which I shall submit to your notice appear to be attempts to deceive other senses.

You are all aware of what takes place when a dog thrusts his nose among a nest of young kittens. Although the tiny creatures can scarcely see, and have had no experience whatever to guide them, they hiss and spit at their hereditary enemy the instant their sense of smell reveals his presence.

Moreover, you will observe that the dog almost always seems startled and taken aback by this curious demonstration of hostility. Now, Nature does nothing in vain, and whenever the habit is found to be constant in all members of the species you may be pretty sure that it is not there by chance, and that at some time it was of considerable value in saving the race from extinction.

If we push our inquiries further, we find the case of the kitten is by no means an unique one. Bats, both old and young, hiss and explode when you explore their holes, so do many birds, such as wood-peckers, titmice, horn-bills and owls, young opossums and phalangers and dasyures manifest the same habit, and a striking example is found in South America among the nyctipitheci, or night apes, an eccentric family of monkeys about which I shall have something further to say if time permits. Now all these hissing creatures, although as you will see at once they belonged to all sections of the animal kingdom, have a common habit of making their nurseries in hollow trees or shallow holes. My suggestion is, here we have clearly the mimicry of the hiss of the snake.

Dr. Robinson went on to say that for an instance of protective mimicry they had to look no farther than the tabby cat on the hearthrug,—he meant the pure tabby,—with large black curved markings. When the cat was curled up asleep those markings formed a spiral, strongly suggestive of a coiled serpent, with a full blotch where the head would be. In the same way margays and ocelots resembled rattle snakes and pythons. He wished them to consider this theory entirely as an open question; it would amuse them even if they did not believe it. His idea was that these animals resembled snakes for their own protection. These markings might be mere vestiges of what existed in former days, when the mammals were feeble creatures, as compared with the great birds and reptiles from which they needed special protection. If the varying species retained the same common trait, it might be said that the trait was peculiar to the original type. The cat's near relatives, like the civet and the genet, also had these longitudinal markings along the back; and there again they got the resemblance to the coiled serpent. The lecturer also drew attention to the viperine appearance of cats when enraged. There was the suggestion of the fangs, and the movement of the tail was snake-like, for snakes when angry jerked their tails to and fro, very much as cats did. The striped tail of the cat, too, had a curious snakelike aspect. He did not say that the resemblance in the case of an enraged cat was very strong, but it would be sufficient to give an enemy a shock and enable the cat to get an advantage. The cat, moreover, uttered sounds very much like those emitted by venomous snakes when about to strike. Their sibilant utterances might generally be regarded as an ultimatum. Cats were the prey of the eagles, but many eagles feared and avoided snakes. He admitted that many difficulties stood in the way of the theory he

had advanced, but they diminished by examination. Jaguars and tigers hissed, and, though it might be thought that such powerful animals did not need the protection of this mimicry of serpents, yet the hissing was probably a survival from the early days when, as he had said, mammals were comparatively feeble creatures, living in a world that swarmed with gigantic birds and reptiles. Almost all animals had a dread of snakes, and he believed that the habit of hissing and spitting had been evolved, in imitation of snakes, as a protection against the mammals' instinctive dread of serpents. As an illustration, the lecturer cited the hissing of kittens and owlets in their arboreal nurseries, the idea being to give the predatory intruder, who thought he had smelt kittens, the impression that the nest in the hollow of a tree was occupied not by kittens but by snakes. He had said nothing so far about the mimicry of snakes by birds, though it would be perfectly easy to employ nearly a whole evening in such illustrations. Take for example the gander, which stretched out its snake-like neck and hissed. The Muscovy duck made the same noise, and the habit was extremely common amongst almost all birds that nested in the reeds by the river side. And not only did they hiss, but they thrust out their necks in a style similar to that of the ganders. This would propably be enough to intimidate a carnivorous creature that might approach. One other instance was that of the little night apes of South America, which made a hissing and spitting noise when anyone approached the entrance to their homes in the trees. Finally, the lecturer said he believed that a large field of investigation awaited someone in connection with this question of protective mimicry amongst mammals.

At the conclusion of Dr. Robinson's Paper, one was read on

THE SEAMEW'S PROVIDER.

BY

Mr. ERNEST ROBINSON.

"Why do the 'Chinton Hounds', as the shepherds in the neighbourhood of Brighton call Seagulls, come in-shore for food when the land is fast bound in frost and other birds are drifting to the coast?" This, said Mr. Robinson, was the question which had crossed his mind and had puzzled him for years. All earthworms (which appear to be the only prey the gulls take inland), should be well below the frost, except a few dry, brown specimens which were caught on the surface by the first sudden frost,

and this hill has been drawn too many times by the pack of Chinton Hounds to leave the least chance of such a find remaining. He now thought that the mystery had been solved, and wrote this article to explain his theory. While crossing an arable field high up on the Sussex Downs during a frost—a place where, after a shower on a summer evening, one may count thirty earthworms to the square yard, and the ground seems to vibrate as they quickly draw in their bodies at the sound of a footstep—he noticed one of the species suddenly eject the greater part of its length from its burrow, and writhe as if in extreme agony.

On taking hold of the creature and withdrawing it from the hole, he found that an insect resembling a centipede had firmly attached itself to the worm's lower extremity. It was armed with a formidable pair of forceps, and so deeply were these embedded in the body of the unfortunate worm that being carried suspended for some half mile did not cause it to relinquish its hold.

The agressor and its victim were deposited together in a box of earth, and on examining the contents next morning the worm was found to be in two portions, which, contrary to the popular belief that each part will form a complete annelid, were both dead.

That this creature is the seagull's provider, by driving the worm above ground within its reach, was the theory suggested by this little episode, and on mentioning it to other naturalists, he was recommended to shoot a few gulls, and endeavour to prove it.

The last day before the protected season for these birds arrived without a specimen being obtained, although large flocks had frequented the district, when about midday he noticed a number of gulls crossing a hillside, and, hastily taking his gun, made for a deep lane over which the flock was passing, in time to stop one of the rearguard.

The bird, a fine specimen of the common gull, dropped without moving a wing. A *post mortem* was made, and on searching the gizzard it was found empty, with the exception of a few clover leaves and nodules of chalk, and he wondered if the object of his search would be found without the slaughter of ten or twelve of these beautiful birds, but, examining the abdominal cavity towards the gullet, a soft substance was discovered, and he drew forth an earth worm, and, still attached thereto (although both were dead) a little brown, centipede-like insect, and, with recollections of my Euclid days, *quod erat demonstrandum* escaped my lips.

In the first instance, Mr. Robinson thought that the specimen was a true centipede, and was confirmed in this idea by an authority to whom it was submitted, but after a time he began to suspect that both were wrong.

On the first really warm day of the season the seagulls disappeared; no doubt their nesting time had come, but he had a strong suspicion, proved by E. T. Booth in the case of gannets, that many sea birds, and also starlings and rooks, do not nest as yearlings. If this is so, some of these would surely have stayed, if the worms were still driven to the surface.

He purposed capturing a few of the so-called centipedes, which are often turned up by the plough, and by keeping them hungry, exhibit their voracity on some unfortunate earthworm at this meeting of the Brighton Natural History Society; but search was fruitless, and it occurred to him that some gentlemen who had seen a specimen, and hinted that it looked very much like the larva of a beetle, were right in their conjecture, and that the creature had now passed into the pupa stage of its existence.

Being in the neighbourhood of Kensington last week, he took the opinion of the Curator of the Insect department of the Natural History Museum on the specimen, and after careful examination it was stated to be the larva of some member of the family Carabidæ.

Much interest was exhibited in its carnivorous habit, and Mr. Robinson was told that comparatively little is known of the life history of the carabid beetles.

As additional proof of this theory it may be added that on dissecting a Redwing thrush which had been shot in frosty weather, there were found in the gizzard remains of both earthworm and beetle larvæ.

If the carniverous larvæ drove the earthworm above ground to fall a prey to the birds without injury to itself, there might be danger of the extermination of a very important factor in the world's fertility, as Darwin tells us of the momentous part that the worm plays in the formation of vegetable mould; but as the seamew devours both agressor and victim the balance of power is not likely to be disturbed, and a meal is provided for the hungry in a season of scarcity.

THE FOLLOWING VALUABLE

LIST OF WEALDEN AND PURBECK-WEALDEN FOSSILS,

HAS BEEN COMPILED FOR THE SOCIETY

BY ITS HONORARY MEMBER,

CHARLES DAWSON, F.G.S., F.S.A., UCKFIELD,

JUNE, 1898.

ABBREVIATIONS.*

H.......	Hastings—Wadhurst clay; Ashdown; Fairlight clay.
Ck. ...	Cuckfield—Upper Wealden Beds.
I. of W.	Isle of Wight— ,, ,,
Br. ...	Brightling } —Purbecks.
P.......	Pounceford } —Purbecks.
Cw. ...	Cowden; Upper Wealden Beds.
H.W.	Heathfield Railway Station Well (Purbecks reached 353 feet).

* The Fossils from the Cuckfield and Cowden districts belong to the Upper Wealden Beds.

Those from the Hastings district are from the Tunbridge Wells sands, Wadhurst clays and Ashdown sands, and Fairlight clays).

The Brightling and Pounceford specimens are from the "Sussex Purbecks" (or rocks which underlie the Fairlight clays).

The Isle of Wight specimens are nearly all from the Weald clay of Brook Point.

MAMMALIA.—Multituberculata.

Plagiaulax Dawsoni (A.S.W.) H.
Bolodon sp., Lyd, H.

REPTILIA.—Sauropterygia.

Cimoliosaurus valdensis, Lyd, H.
Limnophilus, Koken, Ck.

Crocodilia.

Goniopholis crassidens, Owen, H., Ck., Br., I. of W.
Heterosuchus valdensis, Owen, H., Ck., I. of W.
Suchosaurus cultridens, Owen, H., Ck., I. of W.

Hylæochampsa vectiana, Owen, I. of W. (H. ?).
„ sp., I. of W. (H. ?).
Pholidosaurus Meyeri, Dunker, I. of W.

DINOSAURIA.

Hylæosaurus armatus, Mantell, Ck. (I. of W. ?) (H. Teeth ?)
Iguanodon Bernissartensis Blgr., I. of W., Ck.
„ Dawsoni, Lyd, H.
„ Fittoni, Lyd, H.
„ Hollingtoniensis Lyd, H.
„ Mantelli, Meyer, Ck., I. of W.
Hypsilophodon Foxi, Huxley, I. of W., Ck.
Vectisaurus valdensis, Hulke, I. of W.
Pleurocœlus valdensis, Lyd, H.
Megalosaurus Oweni, Lyd, H., Ck.
„ Dunkeri, Koken, H., Ck., I. of W.
Aristosuchus pusillus, Owen, I. of W.
Calamospondylus Foxi, Lyd, I. of W.
Morosaurus brevis, Owen, Cw.
Polacanthus Foxii, Hulke, I. of W.
Polacanthus sp., Lyd, H.
Titanosaurus sp., I. of W.
Ornithopsis Hulkei, Seeley, Cw., I. of W. (H. ?)
Thecospondylus Daviesi, Seeley, I. of W.
„ Horneri, Seeley, Tunbridge.

ORNITHOSAURIA.

Ornithochirus Clavirostris, Owen, Cw., I. of W. (H. ?).
„ ? Clifti, Mant, Ck.
Ornithochirus Nobilus, Owen, I. of W.
„ ? sp., Lyd, I. of W.
„ ? sp., Owen, Ck.

CHELONIA.

Plesiochelys Brodiei, Lyd, I. of W.
„ valdensis, Lyd, I. of W.
Tretosternum sp., Lyd, Ck., I. of W.
Hylæochelys latiscutata, Owen, Br., I. of W.
„ emarginata, Owen, I. of W.
„ Belli, Mantell, I. of W.
Archæochelys valdensis, Lyd, Ck.

PISCES—ELASMOBRANCHII.

Hybodus basanus, Egerton, H.
„ striatulus, Agassiz, Ck.

Hybodus, subcarinatus, Agassiz, Ck.
Acrodus ornatus (A.S.W.) H.
Asteracanthus granulosus, Egerton, Ck., H.

GANOIDEI.

Lepidotus, Mantelli, Agassiz, H.
Cœlodus Mantelli, Agassiz, Ck.
„ hirudo, Agassiz, H., Ck.
Caturus sp. (A.S.W.) H.
Neorhombolepis valdensis (A.S.W.) H.
Belonostomus sp., (A.S.W.) I. of W.
Oligopleurus vectensis (A.S.W.) I. of W.
? Thrissops sp., H.

INSECTA.

*Coleoptera (elytra of), Tunbridge, Weald clay of Wateringbury, H. (Fairlight clay and Ashdown).
Neuroptera (elytra of) H. (Ashdown and Fairlight clay). (Borings in fossil wood).

CRUSTACEA.

*Estheria elliptica, Dunker, H., T. Wells.
* „ v. subquadrata, Jones, H.
*Cyprione Bristowi, R. J., H., Lindfield.
*Cythere faba, Reuss, H.
* „ sp.
*Metacypris, Fittoni, Mant., Atherfield.
Cypridea Austeni, R. J., Peasemarsh and Shotover.
„ Phillipsiana, R. J. (Neocomian), Shotover.
„ verrucosa (var. crassa), R. J. (Neocomian), Shotover.
„ bispinousa, R. J. (Neocomian), Shotover.
„ ? leguminella, Upper Purbeck.
„ fasciculata, E. F., Mid Purbeck.
„ Purbeckensis, E. F. „
„ punctata, E. F. „
„ cornigera, R. J., I. of W.
„ candona Mantelli, R. J., I. of W.
„ Dunkeri, R. J., I. of W.
* „ Fittoni, S., Hythe.
„ Granulosa (Granulata; Forbes), S., Hythe and Haslemere, and Sub-Wealden Boring.
* „ gyripunctata, R. Jones, Sevenoaks.
* „ tuberculata, E, Forbes, H.; I. of W., Hythe and Haslemere.

*Cypridea Spinigera, S., R. J., Uckfield, Hythe and Haslemere
  „ striatopunctata, R. J., Hythe.
* „ valdensis (C. Faba), S., I. of W., Burwash and Lindfield.
Darwinula leguminella, F., I. of W.

ANNELIDA.

Arenenicola, general (worm castings).

MOLLUSCA.—Lamellibranchiata.

Cardium, H. W.
*Corbula sp., Br., Atherfield, Haslemere and Teston.
  „ oblata, H.W.
Cyrena, H.W.
  „ angulata, Sowerby, S. (and generally)
* „ dorsata, Ck.
* „ elongata, S., H. (and generally).
  „ gibbosa (variety of C. Media), generally in Weald.
  „ major, S., generally in Weald.
* „ media, S., „ „
  „ membranacea, S. „
* „ parva, S., „ „
* „ subquadrata, H. and Atherfield.
*Exogyra Bousingaulti, d'Orb, Atherfield.
Ostrea, H.W.
* „ distorta, S., Hythe and Atherfield.
*Unio antiquus, S., Ck., H., Tunbridge.
  „ compressus, S., H.
* „ cordiformus, S., Ck., H., Wheatley and Oxford.
* „ gualteri, Mantell, T. Wells.
  „ Mantelli, S., Ck.
  „ Martini, S., Ck.
* „ porrectus, S., H., Ck.
* „ Stricklandi, Phil, Shotover Kill.
* „ subsimiatus, H. & D., H.
* „ substruncatus, S., H., T. Wells.
* „ valdensis, Mant., I. of W., H., Ck.
  „ sp., H., Ck.
*Potamomya.

Gasteropoda.

Actœon, near T. Wells (Fitton).
Bulla Mantelliana, S., Ck., and near T. Wells (Fitton).
Hydrobia ? H.W.

Melania sp., H.W., and near T. Wells (Fitton).
,, attenuata, S., H.
,, tricarinata, S., Haslemere.
Mylitus sp ? Haslemere.
Neritina, Fittoni, Mant., Ck.
Paludina carinifera, S., H.
* ,, (vivipara) elongata, S., Outwood and generally.
* ,, ,, fluviorum, S., H. and generally.
,, sp. ? S., Hythe, Wheatley and Compton Bay.
*Tornatella, H., Southboro'.
*Vicarya (melania) strombiformis Schl., Shipborne, Tunbridge and Atherfield.

PLANTÆ.—THALLOPHYTA.

Algites valdensis, Sew, H.
,, catenelloides, Sew, H.

CHAROPHYTA.

Chara Knowltoni, Sew, H.

BRYOPHYTA.

Marchantites, Zeilleri Sew, H.

PTERIDOPHYTA.

Equisetites Lyelli, Mant, H.P.
,, Burchardti, Dunk, H.
,, Yokoyamæ, Sew, H.
Onychiopsis Mantelli, Brong, H., Ck.
,, elongata, Geyl, H.
Acrostichopteris Ruffordi, Sew, H.
Mantonidium Göpperti, Ett., H., Ck.
Protopteris Witteana, Schenk, H.
Ruffordia Göpperti, Dunk, H.
,, latifolia, Sew, H.
Cladophlebis longipennis, Sew, H.
,, Albertsii, Dunk, H.
,, Browniana, Dunk, H.
,, Dunkeri, Schimp, H.
Sphenopteris Fontainei, Sew, H.
,, Fittoni, Sew, H.
Weichselia Mantelli, Brong, H.
Tæniopteris Beyrichii, Schenk, H.
,, superba, Sew, H.
,, Dawsoni, Sew, H.

Sagenopteris Mantelli, Dunk, H.
„ acutifolia, Sew, H.
Microdictyon Dunkeri, Schenk, H.
Dictyophllum Römeri, Schenk, H.
Leckenbya valdensis, Sew, H.
Tempskya Schimperi, Cord, H., Ck.

GYMNOSPERMÆ.

Cycadites Römeri, Schenk, H.
„ Saportæ, Sew, H.
Dioonites Dunkerianus, Göpp, H.
„ Brongniarti, Mant, H.
Nilssonia Schaumburgensis. Dunk, H.
Otozamites Klipsteinii, Dunk, H.
„ superbus, Sew, H.
„ longifolius, Sew, H.
„ ? Reiberioanus, Heer.
„ Göppertianus, Dunk, H.
Zamites Buchianus, Ett., H.
„ Carruthersi, Sew, H.
„ latifolius, Sew.
Anomozamites Lyellianus, Dunk, H.
Cycodolepis Dory—H.
„ Eury—H.
Carpolithes, sp., H.
Androstrobus Nathorsti, Sew, H.
Bucklandia anomala, (S. and W.) H., Ck.
Fittonia Ruffordia, Sew, H.
Bennettites Saxbyanus, Brown, I. of W., H.
„ Gibsonianus, Carr, I. of W.
„ sp., H.
„ Carruthersi, Sew, H.
„ latifolius, Sew, H.
Yatesia ? Morrisii, Carr.
Sphenolepideum Kurrianum, Dunk, H.
„ Sternbergianum, Dunk, H.
„ ? subulatum, Heer.
Pagiophyllum crassifolium, Schenk, H.
„ sp., H.
Brachyphyllum spinosum, Sew, H.
„ obesum, Herr, H.
Pinites Dunkeri, Carr, I. of W.
„ Carruthersi, Gard, H.
„ Solmsi, Sew, H.

Pinites Ruffordi, Sew, H.
Nageiopsis heterophylla, Font, H.
Thuites valdensis, Sew, H.
Conites (Araucarites), sp., H.
„ armatus, Sew, H.

PLANTÆ INCERTÆ SEDIS.

Withamia Saportæ, Sew, H.
Becklesia anomala, Sew, H.
Dichopteris ? lævigata, Phill, H.

There are also two unnamed specimens from Hastings, figured in the British Museum catalogue—by Mr. A. C. Heward, Vol. I., p. xxxv., pl. 1, fig. 7, and p. xxxv., pl. 1., figs. 8 and 9. The latter is probably one of the Lycopodiaceæ.

The following collections in the British Museum contain almost all the type specimens above mentioned; many of these are exhibited in the drawers of the Museum, and others may be studied on application to the keeper.

"The Beckles Collection,"
"The Dawson Collection,"
"The Egerton Collection,"
"The Fox Collection,"
"The Mantell Collection,"
"The Rufford Collection."

The following other Museums contain useful specimens for the study of the Wealden fossils :—

The Brighton Museum,
The Cambridge Museum,
The Geological Museum, Jermyn Street, W.,
The Hastings Museum,
The Owen's College Museum,
The York Museum.

Reference should be made to the excellent catalogues now published by the Trustees of the British Museum.

NOTE.—The above list of Mollusca, Crustacea, etc., has been made up from the specimens preserved in the Geological Museum (under the superintendence of E. T. NEWTON, ESQ., F.R.S.), and from the lists of fossils given by SOWERBY, TOPLEY, MORRIS, RUPERT JONES, FORBES, ETHERIDGE, and others.

It is right to say that the Molluscs have not yet been properly described, and the large collection in the British Museum is not yet arranged or catalogued. The specimens above named and marked with an *asterisk* can be seen at the Geological Museum, Jermyn Street, London, W.

A list of the Fossils discovered in the Sub-Wealden, 1872-6 boring, is given in *Dixon and Jones' Geology of Sussex*, p. 160.

METEOROLOGICAL REPORT.

Appended are the customary statistical statements of weather conditions in Brighton for 1897-98. In the two tables the monthly weather is contrasted with the average conditions of the twenty preceding years, and with the corresponding weather in Crowborough. The data for the latter information are derived from Mr. H. Prince's valuable observations.

The chief feature of the year's weather has been the continuance of a very deficient rainfall. This was most marked during the first four months of 1898. The total rainfall of the six months (October and March inclusive) was only 8·2 inches, as compared with an average of 21·1 inches in the twenty-one years, 1877-98. The nearest approach to the deficient rainfall in the six winter months of 1897-98, was in 1879-80, when the amount was 9·5 inches.

ARTHUR NEWSHOLME.

TABLE I.

Month.		Temperature of Air during Month. Highest.	Lowest.	Mean.	Relative Humidity Saturation—100.	Wind. Number of days of N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm	Rainfall. No. of days on which rain fell.	Amount collected in inches.	Sunshine. No. of sunless days.	No. of hours recorded
July	1897 ...	82·2	48·8	64·0	66	3	6	2	—	1	5	5	3	6	6	0·47	1	263·29
	1877-96...	85·0	45·0	61·5		1·5	3·4	0·7	2·1	1·9	12·6	4·2	4·1	0.3	13	2·61	1	212·94
Aug.	1897 ...	78·8	52·0	63·6	74	1	1	—	2	7	8	7	2	3	20	3·10	1	219·76
	1877-96...	82·2	44·3	61·6		2·3	4·3	1·4	2·1	1·2	9·8	5·0	4·2	0·6	13	2·52	1	201·29
Sept.	1897 ...	69·0	41·4	58·2	76	6	3	1	1	—	4	3	5	7	15	2·42	4	148·51
	1877-96...	83·2	35·2	58·0		3·5	6·8	1·1	1·9	1·4	6·8	3·0	4·7	0·6	12	2·70	2	164·11
Oct.	1897 ..	66·0	38·2	54·3	72	8	6	5	3	5	2	2	—	—	5	0·38	3	160·49
	1877-96...	73·0	29·5	51·1		4·1	7·0	1·4	1·8	1·5	6·4	2·8	5·1	0·8	16	4·24	6	121·22
Nov.	1897 ...	60·0	30·0	47·5	84	8	3	6	—	4	3	1	1	4	12	1·53	13	61·75
	1877-96..	63 5	17·9	45·8		3·0	6·0	1·5	1·5	2·6	6·8	3·2	4·5	0·8	16	3·40	10	73·45
Dec.	1897 ...	55·0	27·2	43·3	84	5	2	4	—	8	5	3	—	4	17	3·37	12	74·84
	1877-96...	69·4	17·6	41·4		3·7	6·1	1·2	1·6	1·8	7·4	3 6	5·1	0·5	15	2·64	13	54·70
Jan.	1898 ...	54·0	31·0	45·1	88	6	1	1	1	3	5	5	1	8	8	0·81	17	35·99
	1877-96...	63·6	12·0	39·1		3·7	6·1	1·8	2·5	2·2	6·6	2·5	5·1	0 3	16	2·75	10	60·68
Feb.	1898 ...	54·6	27·2	43·2	87	4	4	—	—	—	6	8	4	2	15	1·20	3	93·33
	1877-96...	58·0	17·4	40·8		2·8	5·7	2·0	2·4	1·8	5·2	3·5	4·0	0·5	13	1·96	6	92·97
Mar.	1898 ..	55·0	28·2	41·8	81	2	13	2	2	--	3	5	1	3	14	0·91	8	107·36
	1877-96..	65·0	20·2	42·2		2·8	7·7	1·8	2·1	1·3	6·3	3·2	5·0	0·7	13	1·81	4	144·83
April	1898 ...	61·0	35·0	48·3	79	3	8	3	3	3	5	1	3	1	10	0·92	1	167·76
	1877-96..	75·4	28·0	46·7		2·7	10·3	1·6	2·4	1·6	5·8	2·3	2·9	0·2	11	1·81	3	186·25
May	1898 ...	70·0	36 8	53·5	78	5	9	2	1	1	1	8	3	1	21	3·22	8	146·92
	1877-96...	78·1	30·0	53·1		3·0	8·6	1·1	3·1	2·3	7·9	1·5	3·0	0·2	10	1·64	1	246·80
June	1898 ...	76·8	42·8	57·6	78	4	8	—	—	3	8	2	2	·3	13	1·31	5	163·35
	1877-96...	85·0	37·0	59·3		2·8	6·5	1·2	2·3	1·6	9·3	2·6	3·2	0·4	11	1·79	1	232 75

N.B.—The Mean Sunshine Records are for the years 1890-96 inclusive only.

TABLE II.

Month.		Temperature of Air During Month.			Mean relative Humidity. Saturation=100.	Wind.									Rainfall.	
						Number of days of										
		Highest.	Lowest.	Mean.		N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm	No. of days on which rain fell.	Amount collected in inches.
January,	Brighton	50·0	26·8	38·2	87	8	9	1	2	2	3	0	5	1	21	2·97
	Crowborough ...	44·3	21·2	33·9	90	3	12	3	4	0	3	0	6	0	21	3 09
February,	Brighton	57·6	30·2	44·0	90	3	1	6	1	1	3	4	4	5	17	3·10
	Crowborough ...	54·6	28·5	41·3	90	0	4	2	2	2	8	1	9	0	17	3·04
March,	Brighton	56·4	32·0	46·0	82	0	2	1	3	5	4	10	3	3	20	4·39
	Crowborough ..	57·8	31·4	43·0	80	2	0	0	5	2	10	3	9	0	21	5·06
April,	Brighton	65·8	31·8	47·7	75	5	4	3	3	4	4	3	2	2	16	2·17
	Crowborough ...	67·0	30·0	44·4	77	1	11	1	2	1	9	1	4	0	16	2·20
May,	Brighton	74·6	35·0	53·2	68	7	7	—	—	2	8	—	3	4	12	1·89
	Crowborough ...	69·8	32·1	49·9	68	6	9	0	1	2	8	1	4	0	11	1·66
June,	Brighton	78·2	46·0	60·8	78	2	6	1	4	2	5	5	1	4	11	3·33
	Crowborough ...	82·2	41·6	59·4	76	1	11	0	3	5	7	0	3		7	1·78
July,	Brighton	82·2	48·8	64·0	66	3	6	2	0	1	5	5	3	6	6	0·47
	Crowborough ...	79·0	48·2	62·3	67	5	8	0	0	3	7	2	6	0	7	1·45
August,	Brighton	78·8	52·0	63·6	74	1	1	0	2	7	8	7	2	3	20	3·10
	Crowborough ...	82·0	48·8	60·4	72	0	2	2	2	0	17	6	2	0	15	3·14
September,	Brighton	69·0	41·4	58·2	76	6	3	1	1	0	4	3	5	7	15	2·42
	Crowborough ..	68·0	37·3	54·2	78	1	6	2	1	1	11	1	7	0	16	3·27
October,	Brighton	66·0	38·2	54·3	72	8	6	5	3	5	2	2	—	—	5	0·38
	Crowborough ...	64·5	38·2	51·4	77	3	4	3	9	2	4	1	5	0	7	0·36
November,	Brighton	60·0	33·4	47·5	84	8	3	6	0	4	3	1	1	4	12	1·53
	Crowborough ...	58·8	29·3	43·8	87	2	5	4	8	4	7	0	0	0	13	1·73
December,	Brighton	55·0	27·2	43·3	84	5	2	4	0	8	5	3	0	4	17	3·37
	Crowborough ...	52·5	27·6	40·7	74	0	3	4	4	5	12	1	2	0	15	4·14
Entire Year,	Brighton	82·2	26·8	51·7	78	56	50	30	19	41	54	43	29	43	172	29·12
	Crowborough ...	82·2	21·2	48·7	78	24	75	21	41	27	103	17	57	0	156	30·29

SATURDAY, JUNE 11TH, 1898.

Annual General Meeting.

REPORT OF THE COUNCIL

FOR THE YEAR ENDING JUNE 11TH, 1898.

The records of the Society for the past year show one notable departure from those of previous years. It is in the institution of Lectures under the auspices of the Society, to which the public are admitted on payment.

A Lecture Guarantee Fund was started in the beginning of the year in connection with the scheme, and soon reached a total sum of between two and three hundred pounds. Mr. Selous was engaged, and his admirable lecture in the Dome on "Travel and Adventure in South Africa," was in so far a success that no loss fell on the guarantors. There is little doubt that a considerable amount would have accrued to the Lecture Fund had the weather not been so unpropitious.

Encouraged by the result of this experiment, it is proposed that two or three Lectures shall be given next Session. It is also hoped that a programme of Lectures to be given before the Society, and of papers to be read at its Meetings, may for the first time in the history of the Society be issued before the commencement of the next Session.

The Council regrets that the Meetings of the Sections have not been better attended, but trusts that as their work becomes more widely known, and as the Membership of the Society increases, they will receive more support than has hitherto been accorded to them.

A Meeting of the S.E. Union of Scientific Societies with which this Society is affiliated, was held at Croydon on the 2nd, 3rd, and 4th inst. The Meeting was attended by Messrs. J. P. Slingsby Roberts, Breed, Davey, and Pankhurst, the Delegates appointed by the Council.

They conveyed an invitation from the Council to the Union, inviting it to meet at Brighton in June next year. It appears, however, from their report, that Rochester was selected as the

place of Meeting for 1899, but a hope was expressed that the invitation to visit Brighton would be renewed for the following year, when no doubt it would be accepted.

During the past year the Society has lost three Members by death and five have resigned. Nineteen new Members have, however, been elected, showing an increase in the year of eleven Members.

The following is the list of Excursions—

12th June, 1897, Newick Park.
10th July, „ Crowborough.
30th April, 1898, Cuckfield.
14th May, „ Chailey Common.

PHOTOGRAPHIC SECTION.

ANNUAL REPORT.

Chairman : Mr. W. Clarkson Wallis.

Committee : Messrs. J. P. Slingsby Roberts, Douglas E. Caush, W. W. Mitchell, W. H. Payne, E. J. Elgee, and C. Berrington Stoner.

Hon. Secretary : Mr. R. Chappell Ryan, 43, Compton Avenue.

Your Committee have to report that eight Sectional Meetings have been held, and as last year, the attendance has only been fair. Of these Meetings, one was held as a " Members' Evening, for discussion of photographic matters and mutual criticism of prints, etc. Four evenings were given up to the reading of Lantern Lectures, on loan from the Editor, *The Amateur Photographer ;* these lectures were mostly instructive in their character. Two evenings were devoted to the exhibition of the *Amateur Photographer* and *Photography* prize slides for '97 ; these two Meetings were participated in by the Members of the Hove Camera Club. The other evening was occupied by the Hon. Secretary, who gave some hints on "Instantaneous Photography."

The Annual Competition was held in November. Fifty-six prints were sent in and one set of lantern slides ; eight awards were made, and these were distributed amongst three of the seven competitors.

The past year has not been marked by any particular event, neither has the scheme for a "Photographic Survey" been forwarded.

The adoption of this report was proposed by Mr. Pankhurst and seconded by Mr. Elgee. Carried.

Signed on behalf of the Committee,

R. C. RYAN,

Hon. Secretary.

BOTANICAL SECTION, 1897.

ANNUAL REPORT.

One Meeting was held, and the Committee and Officers re-elected.

A considerable number of Specimens added to the Society's Herbarium were exhibited, and a vote of thanks passed to the contributors. Cards issued by the Secretary having failed in securing attendance at a later Meeting, there is nothing further to report.

T. HILTON, *Secretary.*

Since last year's Report, the following comparatively rare plants (all gathered in Sussex) have been added to the Society's Herbarium.

Sedum album (White Stonecrop), Fishersgate Cliff.
Medicago minima, Camber Sands.
Trigonella purpurascens, Aldrington Beach.
Arenaria tenuifolia, Stanmer Downs.
Silene gallica, a Anglica, Telscomb.
Lepidium ruderale.
Cochlearia Anglica, Fishbourne.
Melissa officinalis, Southease.
Lamium incisum, Keymer.
Ruppia spiralis, Cuckmere Haven.
Rumex Hydrolapatheum, b. latifolia, Lewes.
Rumex acutus, Henfield.

Centaurea solstitialis, Ovingdean.
Hypochaœris glabra, Camber Sands.
Bartsia viscosa, Chailey.
Dianthus prolifer, near Selsey.
Dianthus deltoides, Hassocks.
Hippophæ rhamnoides, Camber Sands.
Epipactis palustris, near Poynings.
Juncus maritimus, Fishbourne.
Setaria viridis, Patcham.
Sisymbrium pannonicum, Brighton.
Bromus secalinus, b. velutincus, Pyecomb.
Festuca ambigua, Camber Sands.
Glyceria maritima, Fishbourne.
Carex axillaris, Birdham.
Blysmus compressus, Fishbourne.
Fumaria pallidiflora, Wartling.
Potamogeton trichoides, Iford.
Ballota nigra, var. ruderale, Fishersgate.
Lathyrus hirsutus, near Stanmer.
Vicia lathyroides, Camber Sands.
Trifolium glomeratum, Camber Sands.
Delphinium Ajacis, Brighton.
Chenopodium ficifolium, Goldstone Bottom.

REPORT OF THE DELEGATES

TO THE MEETING OF THE S.E. UNION OF SCIENTIFIC SOCIETIES, HELD AT CROYDON, ON JUNE 2ND, 3RD AND 4TH, 1898.

We beg to report to the Council that in obedience to its request we duly attended the Meeting at Croydon. On Thursday evening Professor Boulger delivered the inaugural address; on Friday and Saturday papers were read and discussed on different scientific subjects. At the Meeting of Delegates on Saturday morning, the President of this Society, Mr. J. P. Slingsby Roberts, presented the invitation authorized by the Council to meet at Brighton next year, and urged on the Delegates the claims which Brighton had to the honour of a visit. There were certain circumstances, however, connected with Rochester and the

Natural History Societies of that and the adjacent towns which decided the Delegates on choosing Rochester as the place of Meeting for next year. A hope was, however, expressed that the invitation from Brighton would be renewed next year, when no doubt it will be accepted for 1900. As a full report of the proceedings at the Meeting will be sent to the Society, it is not necessary perhaps to enter into further detail with regard to them.

(Signed) J. P. Slingsby Roberts,
Edward Alloway Pankhurst,
H. Davey, Junr.,
Edward A. J. Breed.

LIBRARIAN'S REPORT.

During the past year, 96 books and periodicals have been issued on loan, and the library has also been used for reference purposes by the general public. As the Society is now affiliated to the British Association, the valuable Reports of the latter will henceforth be given to our library; and the Report of last year's meeting held at Toronto has already been received. Besides the serials to which the Society subscribes, the only addition by purchase to the library has been Bateson's *Materials for the study of Variation.* The publications of the United States Geographical Survey and Smithsonian Institution are specially valuable gifts. The Society has also to thank Mr. Arthur Griffith for the donation of two volumes of Memoirs, and a number of serials.

HY. DAVEY, Jun.

Brighton and Sussex Natural History and Philosophical Society.

TREASURER'S ACCOUNT FOR THE YEAR ENDING 8th JUNE, 1898.

Dr.

1898.	£	s.	d.
To Balance in the hands of the Treasurer, 9th June, 1897	7	12	1
,, Annual Subscriptions and arrears to 1st October, 1897	8	0	0
,, Annual Subscriptions to 1st October, 1898 ...	60	0	0
,, Annual Subscriptions to 1st October, 1899 ...	0	10	0
,, Entrance Fees...	2	10	0
,, Associate's Subscription to 1st October, 1898 ...	0	2	6
,, Amount of Subscription overpaid	0	0	6
,, Dividends on £100 $2\frac{3}{4}$ per cent. Consolidated Stock, for one year to April, 1898	2	15	0
	£81	10	1

	£	s.	d.
Balance in the hands of the Treasurer, 8th June, 1898	7	4	0

There is a sum of £100 $2\frac{3}{4}$ per cent. Consolidated Stock invested in the names of the Hon. Treasurer and Hon. Secretaries as Trustees for the Society.

Cr.

1898.	£	s.	d.
By Books and Periodicals	7	16	7
,, Bookbinding	1	3	6
,, Printing Annual Report and Abstract of Proceedings...	9	19	6
,, Printing and Stationery, General	6	1	7
,, Postages, &c., General	11	16	4
,, Scientific Secretary, Honorarium for the current year...	10	0	0
,, Subscriptions to Societies	3	9	10
,, Clerk's Salary (E. P. Golding)	2	2	0
,, Commission to Collector of Subscriptions ...	2	17	3
,, Gratuities to Assistants at Museum	3	0	0
,, Expenses of Meetings	7	12	3
,, Expenses of Excursion and Secretaries' Incidental Expenses	0	5	6
,, Photographic Section, Stationery, Printing, Postage, Exhibition, and Incidental Expenses	6	18	3
,, Microscopical Section Expenses	0	5	6
,, Fire Insurance Premium on Books	0	18	0
,, Balance in the hands of the Treasurer, 8th June, 1898	7	4	0
	£81	10	1

Audited with books and vouchers and found correct.

F. G. CLARK, F.C.A., *Hon. Auditor.*

September, 1898.

RESOLUTIONS, &c., PASSED AT THE ANNUAL GENERAL MEETING.

After the Reports and Treasurer's Account had been read, it was proposed by Dr. Morgan, seconded by Miss Cameron, and resolved—

> "That the Report of the Council, the Treasurer's statement, the Librarian's Report, and the Reports of the Committees of the several Sections now brought in be received, adopted, and printed for circulation as usual."

It was proposed by Mr. Pankhurst, seconded by Mr. Harrison—

> "That Rule 1 of the Society be altered by substituting the word 'Hove' for the word 'Sussex' in this Rule."

The following amendment was proposed by Mr. E. A. T. Breed, seconded by Mr. H. Davey.

> "That the name of the Society be the Brighton, Hove and Sussex Natural History and Philosophical Society."

The amendment was put to the Meeting and declared lost.

The resolution was put and declared carried.

It was proposed by Mr. Pankhurst, seconded by Mr. Breed, and resolved—

> "That Rule 25 be altered by adding the words 'or other Members after the words 'past Presidents' in this Rule."

It was proposed by Mr. Pankhurst, seconded by Mr. Haselwood, and resolved—

> "That Rule 49 be altered by adding after the word 'Meetings' the words 'unless otherwise determined by the Council in respect of any Meeting or Meetings, of which determination due notice shall be given.'"

The Secretary reported that in pursuance of Rule 25, the Council had selected the following gentlemen to be Vice-Presidents of the Society for the ensuing year—

> "Mr. J. E. Haselwood, Dr. A. Newsholme, Mr. D. E. Caush, Mr. E. J. Petitfourt, B.A., F.C.P., Mr. J. P. Slingsby Roberts, and Dr. E. McKellar, Dep. Surg. Genl., J.P.

And that in pursuance of Rule 42 the Council had appointed the following gentleman to be Honorary Auditor—

"Mr. F. G. Clark, F.C.A."

The Secretary also reported that the following gentlemen who had been elected Chairmen of Sections would, by virtue of their office, be Members of the Council—

"*Photographic Section:* Mr. W. C. Wallis; *Botanical Section:* Mr. J. Lewis; *Microscopical Section:* Mr. D. E. Caush; and that the following gentlemen who are Secretaries of Sections would also, by virtue of their office, be Members of the Council:—*Photographic Section:* Mr. R. C. Ryan; *Botanical Section:* Mr. T. Hilton; *Microscopical Section*: Mr. W. W. Mitchell.

It was proposed by Mr. Edmonds, seconded by Mr. E. J. Petitfourt, and resolved—

"That the following gentlemen be officers of the Society for the ensuing year:—*President*: Dr. W. J. Trentler; *Ordinary Members of Council*: Dr. R. Black, Mr. Harrison, Mr. W. W. Mitchell, Mr. Morgan, Mr. Payne, and Mr. W. Clarkson Wallis; *Honorary Treasurer*: Mr. E. A. T. Breed; *Honorary Librarian*: Mr. H. Davey, Jun.; *Honorary Curator*: Mr. B. Lomax, F.L.S.; *Honorary Secretaries:* Mr. Edward Alloway Pankhurst, 3, Clifton Road, Mr. J. Colbatch Clark, 64, Middle Street; *Assistant Honorary Secretary*: Mr. H. Cane."

The following amendment was proposed by Mr. Pankhurst, seconded by Mr. Davey, and carried—

"That Dr. Waring and Mr. J. Lewis, F.S.A., be elected Ordinary Members of the Council in the place of Mr. W. C. Wallis and Mr. W. W. Mitchell, *ex-officio* Members."

It was proposed by Mr. J. Wells, seconded by Mr. Harrison, and resolved—

"That the sincere thanks of the Society be given to the Vice-Presidents, Council, Honorary Librarian, Honorary Treasurer. Honorary Auditors, Honorary Curator, and Honorary Secretaries for their services during the past year."

It was proposed by Mr. H. Davey, Jun., seconded by Mr. T. Hilton, and resolved—

"That the sincere thanks of the Society be given to Mr. J. P. S. Roberts for his attention to the interests of the Society as its President during the past year."

Eastbourne Natural History Society.
Edinburgh Geological Society.
Epping Forest and County of Essex Naturalist Field Club.
Folkestone Natural History Society.
Geologists' Association.
Glasgow Natural History Society and Society of Field Naturalists.
Hampshire Field Club.
Huddersfield Naturalist Society.
Leeds Naturalist Club.
Lewes and East Sussex Natural History Society.
Maidstone and Mid-Kent Natural History Society.
North Staffordshire Naturalists' Field Club and Archæological Society.
Peabody Academy of Science, Salem, Mass., U.S.A.
Quekett Microscopical Club.
Royal Microscopical Society.
Royal Society.
Smithsonian Institute, Washington, U.S.A.
South-Eastern Union of Scientific Societies.
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Watford Natural History Society.
Yorkshire Philosophical Society.

Attree, G. F., 8, Hanover Crescent.
Ashton, C. S., 3, Chatsworth Road.
Abbey, Henry, Fair Lee Villa, Kemp Town.

Burchell, E., L.R.C.P., 5, Waterloo Place.
Brown, J. H., 6, Cambridge Road, Hove.
Badcock, Lewis C., M.D., M.R.C.S., 10, Buckingham Place.
Balean, H., 15, Alexandra Villas.
Booth, E., 70, East Street.
Baber, E. C., M.B., L.R.C.P., 46, Brunswick Square.
Burrows, W. Seymour, B.A., M.R.C.S., 62, Old Steine.
Billing, T., 86, King's Road.
Black, R., M.D., 14, Pavilion Parade.
Bevan, Bertrand, Withdean.
Breed, E. A. T., 72, Grand Parade.
Beckwith, C., 114, Church Road, Hove.

Clark, John Colbatch, 64, Middle Street.
Cox, A. H., J.P., 35, Wellington Road.
Cane, H., 64, Middle Street.
Cowley, E. R., 12, Stanford Avenue.
Catt, B. W., 44, Church Street.
Caush, D. E., L.D.S., 63, Grand Parade.
Clark, F. G., 56, Ship Street.
Cowell, Samuel, 9, Preston Park Avenue.
Couchman, J. E., Down House, Hurstpierpoint.

Davey, Henry, J.P., 82, Grand Parade.
Day, Rev. H. G., M.A., 55, Denmark Villas, Hove.
Denman, Samuel, 26, Queen's Road.
Dodd, A. H., L.R.C.P., M.R.C.S., 14, Goldstone Villas, Hove.
Davey, Henry, Junr., 82, Grand Parade.
Deedes, Rev. Canon, 2, Clifton Terrace.
Douglas, F., B.Sc., 14, Clifton Terrace.

Edmonds, H., B.Sc., Municipal School of Technology.
Ewart, Sir J., M.D., F.R.C.P., M.R.C.S., F.Z.S., Dyke Road.
Elgee, E., Mountjoy, Preston Road.

Fletcher, W. H. B., Fair Lawn House, Worthing.
Friend, D. B., 77, Western Road.

Grove, Edmund, Norlington, Preston.
Griffith, Arthur, 59, Montpelier Road.

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Hobbs, James, 62, North Street.
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Lewis, J., 37, Preston Road.
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Mitchell, W. W., 66, Preston Road.
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Martin, C., 45, Montpelier Road.
Maguire, E. C., 41, Grand Parade.
Muston, S. H., 54, Western Road.
May, F. J. C., 25, Compton Avenue.

Newsholme, A., M.D., M.R.C.P., 11, Gloucester Place.
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Newmarch, Major-General, 6, Norfolk Terrace.
Nicholson, W. E., F.E.S., Lewes.
Nicholson, Mrs., 9, Park Crescent.

Pankhurst, E. A., 3, Clifton Road.
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Penney, S. R., Larkbarrow, Dyke Road Drive.
Perry, Aylett W., Annesly Hall, Dyke Road.
Prankerd, Dr., 6, Evelyn Terrace.
Payne, E., Cuckfield.

Rutter, J., M.D., M.R.C.S., 142, Western Road.
Ross, Douglas M., M.B., M.R.C.S., 9, Pavilion Parade.
Rose, T., Clarence Hotel, North Street.
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Thoms, H. S., Museum, Church Street.

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BRIGHTON AND HOVE

Natural History & Philosophical Society.

ABSTRACTS OF PAPERS

READ BEFORE THE SOCIETY,

TOGETHER WITH

THE ANNUAL REPORT

FOR THE

Year ending June 14th, 1899.

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SESSION 1898-1899.

WEDNESDAY, OCTOBER 12TH, 1898.

INAUGURAL ADDRESS

BY

DR. W. J. TREUTLER, F.L.S.

(PRESIDENT), ON

"Music in its Relation to Man and Animals."

DR. TREUTLER began by pointing out that one of the charms of the study of Nature is that as soon as we look beneath the surface, what strikes the superficial observer as common-place, becomes at once a source of fascinating interest and admiring wonder. "This is eminently the case," he remarked, "with the phenomena connected with the occurrence and production of sound in animated Nature from man down to the humblest insect. Nature is full of living sounds of a more or less musical character. . . These all have their meaning, and the Naturalist asks, What is their origin and source, their cause and their motive?" Even if it were possible, the answering of these queries would, the Doctor said, occupy more time than was at his disposal then, and all he could do was to offer some thoughts and suggestions. He defined "music" broadly, for the present purpose, as "a succession of sounds so combined and modulated as to please not only *our* ear but *some* ear"—the object of music being the gratification of the sense of hearing. "In the Mammalia, including man, and in birds, sounds are produced by an organ specially adapted for the purpose—the larynx, an open tube across which are stretched certain structures termed the vocal cords. These are governed by certain muscles, and can be thrown into vibrations more or

less rapid by an expelled current of air. But in insects, sound is produced by a very different arrangement, namely, by the friction of certain string-like structures in the wings or in some cases on the legs, against certain plates or membranes, which are often stretched across a cavity situated on the side of the body, the whole resembling in general character and principle our various stringed instruments. Besides these more common sources of sound, the wings are often variously used by birds for the production of different kinds of sound, and in these the feathers are often curiously modified to serve a like purpose.

Now, we know that nearly all the characters, proceedings, and properties of animals have reference to the struggle for existence, and are useful to them either in procuring food or as a means of defence, and that it is a distinct advantage to them to acquire or bring to perfection certain characters or organs; and the vocal organs or other means of producing sound certainly are of use to them in this respect, and so come within the operation of the law of natural selection. This applies to the cries and call notes of most animals, which serve, as I have already said, as a means of communication or of recognition between communities and individuals or as warnings against danger. But the case appears different in regard to their more strictly musical performances. And here a remarkable fact appears to furnish a clue to the question of the use and purpose of animal music, whether vocal or instrumental. We find, namely, that in most animals, especially birds and insects, the possession of musical powers is limited to the male, and further that these powers are actively exercised by the male exclusively during the season of courtship and mating. This would indicate that the employment of music by animals is, often at all events, of a sexual character, and serves to charm and attract the female, and numerous observations show that this is so. And very often animals, notably birds, combine for this purpose music with remarkable gestures and antics and regular dances; as witness the performances of various species of gallinaceous birds,—the capercailzie, blackcock, grouse, jungle fowl, and others. I have seen in India, in an open spot in the midst of a dense jungle, a single peahen surrounded by a circle of 15 to 20 admiring peacocks, in full and magnificent plumage, with their glorious tails erect and displayed to the fullest extent. These kept up a chorus of loud and energetic screams, all the while dancing and leaping around the lady, who, though apparently wholly indifferent to these attentions and calmly pecking about in the grass for worms, was no doubt perfectly conscious all the while of being the object and centre of so much homage. In their case the end and issue of their performance were lost, for, becoming conscious by

some means of being observed and watched, the whole party, hen and all, precipitately took to flight and disappeared.

Other music than that with which the love-lorn creature tries to give expression to its feelings then came under consideration. Monkeys, said Dr. Treutler, might literally be said to sing, for they utter musical sounds in ascending and descending scales, with intervals of almost exact semi-tones. Several other animals sing in true cadences of definite notes, notably the white-banded mocking bird. Of him it was said, "This bird will begin his performance by reproducing for the first half-hour with marvellous fidelity the more or less melodious songs of a score of species, and then, as if to show off by contrast his own greatly superior powers, he will pour forth his own divine song with a power and wild abandon in a continuous torrent of joyous notes of surprising brilliance and variety. Hudson likens the song of this bird to a melody sweetly played in tune, the notes never coming in the same order again and again, but with endless variations, like the most artistic improvisation, the song being accompanied all the while with the most graceful and appropriate and harmonious movements. These outpourings, Dr. Treutler demonstrated, were certainly not the "song of yearning or unsatisfied love." It was rather an expression of joy and gladness. He would go so far as to say that music existed in all animals as a part of their nature, and was employed by them to express emotion or feelings under various forms of excitement.

Discussing the question of music amongst man, Dr. Treutler said, "Whereas the vocal and musical powers of animals, birds, and insects are practically the same now, at the present day, as they were thousands of years ago, the music of man has advanced from crude and rudimentary forms and has developed into an Art. The note of the cuckoo, the song of the nightingale, or of the La Plata mocking bird are the same now that they were ages ago and long before man appeared upon the scene." Granting even that sexual selection may have influenced and determined the development of music in its early stages, it was wholly insufficient to account for the vast progress and high degree of refinement of modern music. A capacity for music might exist without any high development of the musical art. It would appear (he said) that the sense of music is and has been inherent in human nature from the earliest times; that musical faculties and talents may be latent in races and dormant in individuals requiring but a suitable combination of circumstances for their development and adequate training and exercise to bring them to perfection. A noteworthy instance of this is furnished by the Jews, who have within the last 100 years developed to a remarkable degree their musical capacity with which they appear to have been endowed from very early times, but

which had laid dormant in them for more than 18 centuries. If was their emancipation which afforded them the opportunity ot unfolding and developing their sense and talent for music, and enabled them to excel in every department of the musical art, and to furnish us with performers and creators of music, such as Mendelssohn, Meyerbeer, Rubinstein, Joachim, and many others. Music was an invention. The experiences and attainments of one generation of men were handed down by tradition to the next generation, and so progress was made, but animals, learning nothing from the experience of ancestors, made no progress. Music with birds was but speech. Regarding the improvements in music, Dr. Treutler said the instrument within ourselves, which is at once the seat and source of musical perception and susceptiblities, our soul, is and has been inherent in man through all time, and has advanced but little, if at all ; but being exercised and trained from early life by better methods and on higher work, it yields proportionately higher and better results. The history of all advance and improvement in the art of music proves this. We have only to think of the reception which Beethoven's choral and other symphonies, and Wagner's operas, met with at the hands of audiences and performers on their first appearance, and compare it with the estimation in which these great works are held now by the public. The musical sense of those days, though by no means of a mean order, was yet unable to grasp and understand the meaning of these great tone poems ; it required the training and education of years to enable our musical faculties to intelligently appreciate these creations of genius.

The Lecturer inclined to the theory of Professor Weissman, that the faculty of music must be regarded as in a manner an outgrowth, a bye-product, of the sense of hearing. Weissman argues that we may regard the musical, and, indeed, every artistic faculty, as the spiritual hand which plays on that part of our inner nature which we call the soul. For our faculty of music consists of two parts,—the organ of hearing and the auditory centre of the brain. The former, the ear, receives the waves of sound, converts them into nerve vibrations, and transmits them to a certain part of the brain,—the auditory centre,—which converts these nerve vibrations into tone perceptions, which are arranged and analysed and combined by the intellect, and so ultimately form that mysterious and potent subtle thing we call music. In animals not only were the sense of hearing and the cerebral auditory centre considerably developed and organised, but they were also able to some extent to intellectually comprehend and interpret music itself.

After instancing the effect of music on certain animals, notably the way war-horses understood bugle calls, Dr. Treutler

went on :—Now, from all this it is evident that for the full and thorough understanding and intelligent comprehension of the higher forms music as we have it at the present day, there is necessary something more than the external organ of hearing and the cerebral auditory centre, however highly these may be developed and exercised in the individual. And this "something more" is a sensitive, feeling, impressible, and highly-organised *soul;* we must have on the one hand the material ear of the body, and on the other hand the spiritual ear of the mind, and the influence exercised by the former, the material organ, on the latter, the spiritual and immaterial organ, and the effects produced, and the nature and degree of the response elicited, must vary according as the soul is more or less highly developed. It is the soul, that mysterious but very real component of man's nature, which is acted on, in a manner played upon as an instrument by the material perception of sound; and the more perfect the instrument the greater will be the effect produced. So that the intelligent comprehension of music even by the higher animals will always be more or less imperfect, because their soul is of a lower order, their intelligence is unable to grasp and comprehend the sequences and rich combinations of musical sounds. And hence the effect of music on animals cannot be other than fragmentary and imperfect; it can at least be only in the most general and superficial way, agreeable or otherwise, but there cannot be any approach to a comprehension of the deep and subtle meanings of music, of major or minor keys, or of musical form.

This musical soul of man is capable of progress and development by education, cultivation, and training, and has been so developed from one generation to another, and from the days of primitive man. Doubtless this process of development of the musical art, like that of all other Arts, dated back to a very early age; but unlike the sister Arts of painting, poetry, sculpture, and the like, the musical Art has progressed by slow and unequal stages. The ancient Greeks have left us abundant evidence of the height attained by them in these sister Arts; but what do we know of their music?

Thus we see that music, in its elementary stages, is but a congeries of vague sounds and indefinite noises "without form and void," to which we can hardly apply the term "music"; but it has ever been the manner and means by which most living beings express their state of mind; while music as an Art becomes more than an imitation of external things, as is the case more or less with the other Arts, but it is the expression of the inmost being of man and of his profoundest feeling and emotions. Thus the study of the evolution of music from the rudimentary stage of expressive noises and cries is one of

extreme interest, with the gradual acquisition and invention by degrees of melody and rhythm, scales and harmony, until it reaches its full development in the choral and instrumental music of modern times. Though it has reached so high a state of development, yet we cannot, may not, suppose that no further progress is possible, and in truth its capabilities of progress are only limited by the like capabilities of the human soul and intellect of the human race itself. At first a mere toy and plaything, it has by long continued serious effort, and earnest, reverent cultivation, risen to the dignity of the highest form of Art, exercising the most humanising influence on man, and embodying his noblest sentiments and aspirations.

Petroleum in Sussex.

PAPER READ BY

MR. C. DAWSON, F.G.S., F.S.A., &c.,

AT AN

EXCURSION OF THE SOCIETY TO HEATHFIELD,

JUNE 11TH, 1899.

THE discovery, which has been recently announced, of petroleum in East Sussex resolves itself into the fact that gas or vapour such as emanates from petroleum has been found to exist in the underlying strata in that part of England. Some little time back the Brighton Railway Company sought to obtain an enlarged supply of water for the service of their locomotives on the Tunbridge Wells and Eastbourne line. For this purpose a boring was commenced at the Heathfield Railway Station, which, in reality, is situated in the parish of Waldron, whereby the latter name is sometimes applied to this particular undertaking. As the work proceeded, and the bore-hole went deeper into the earth, there was an unmistakeable odour such as might proceed from oil of an inflammable nature. At length a light was applied to the mouth of the pipe leading up from the bore-hole,

PETROLEUM IN SUSSEX:
Gas from the Boring at Heathfield Station.

(By kind permission of *Black and White.*)

and at once a brilliant flame rose up to an altitude of about fifteen feet, the diameter of the pipe being nearly six inches. The flame was extinguished with some difficulty, and as it was found afterwards that more gas continued to flow, the attempt to find water was abandoned, a depth of three hundred and seventy-seven feet having been reached. The pipes which lined the bore-hole were withdrawn, except that a short length was left at the top, to which a cap was affixed, so as to limit the flow of gas, if not arresting it altogether. But the gas continued to assert itself, escaping at every joint which remains, although blocked at the summit. The pipe projects up from the bottom of a shallow well or shaft, and it is in that part the leakage takes place. On a light being applied by the Station Master, Mr. Head, who descended the shaft for the purpose, ignition ensued round the circumference of the pipe where the joint existed. Evidently it only needed the removal of the cap in order for the huge jet, fifteen feet high, once more to show itself.

To this point reference will be made presently, but for the present it will be interesting to notice a circumstance not hitherto recorded. About three years ago a boring was made in search of water in the stable-yard of the Heathfield Hotel, also in the parish of Waldron, the site being some seventy feet higher than the top level of the Station boring, and about a hundred yards distant. At a depth of two hundred and twenty-eight feet an oily odour was observed, and gas became evident. As there happened to be water in the tube, the gas, as it rose, caused an ebullition which might be described as boiling without heat. The foreman in charge of the works piped off the gas to a distance of several feet, and there consumed it, the flame rising to what was called "the height of a man." The boring was then carried down about twenty feet further, but as gas continued to come instead of water, the undertaking was abandoned, and the fiery pit was sealed up with concrete. The incident serves to show that the discovery at the Heathfield Station was not the mere result of a lucky hit, but was caused by the presence of a gas which also existed at a higher level and at a distance of a hundred yards. But the area is far wider than this, gas having manifested itself several miles off, in the Sub-Wealden boring at Netherfield.

The gas from the boring at the Heathfield Station has been examined by Mr. Woodhead, the Public Analyst of East Sussex, who pronounces it to belong to the paraffin series. This at once connects it with petroleum. But where is the petroleum which throws off the gas? Mr. Dawson considered the balance of probability to be in favour of the conclusion that the gas is derived from the Kimmeridge clay which underlies the Purbeck beds. This view he entertains, although the

latter beds contain dark leathery shales, which emit a strong odour of petroleum. But the Kimmeridge clays are specially characterised by indications of the oil, and their shales have been worked during past years in Dorsetshire, where petroleum has been obtained from them by distillation. The most interesting part of the problem is whether free petroleum may be met with at a lower depth. The experience in America is that the gas is first encountered, and the oil comes later on. The gas seeks to rise, and in so doing impregnates the rocks which lie above it. Let a free vent be given, and the gas rushes to the surface, as we see at Heathfield. The pressure exerted by the gas is shown by the obstacles it overcomes. At Heathfield the removal of the lining tubes from the boring has caused portions of earth to fall in from the sides and partially block the channel. There is also water in the boring, creating a considerable downward pressure. Still the gas ascends, and shows a good amount of force at the surface, while leaking at every joint. The lighting power of the gas is described as equal to twelve and-a-half candles on the usual scale. Burnt on the incandescent principle, in a mantle, it produces an admirable light. But, as pointed out by Mr. Woodhead, this is obviously due to its heating power, which is considerable. It is described as free from impurities, and has but little odour. The Analyst states that it smells like petroleum.

It is said that the quantity of gas escaping from the single bore at Heathfield would yield a sufficient supply for lighting a small town, and it has been suggested that it might be "piped off" to illuminate Hailsham, Eastbourne, or Tunbridge Wells. Supposing this to be too sanguine a view of what might be done with the present supply, it seems a matter for regret that the gas should either be wasted or absolutely bottled up in the depths of the earth. More important still is the consideration whether the existing flow indicates the existence of a large and valuable store, to be discovered by further search. The gas has given tokens of its presence over a rather wide area, and it may possibly be found at greater distances. The depth also has to be borne in mind, and by seeking to find the actual starting-point of the gas we may attain to what would be termed the fountain-head of the gaseous stream. It may be asked—If the gas is good for anything, why do not the Brighton Company lay it on for the purpose of lighting up the Heathfield Station? It is remarkable that the discovery at the Heathfield Hotel was so completely disregarded. "Natural gas" appears to be at a discount in the neighbourhood. In the public interest, and their own, it would now seem to devolve on the Railway Company to take the matter up, and have it thoroughly investigated.

It has been mentioned that the Heathfield Railway Station

is in the parish of Waldron. The well-known geologist, Gideon Mantell, who disposed of his geological collection to the British Museum for five thousand pounds, and afterwards received a pension from the Crown, has recorded in his work on the Geology of Sussex, published in 1822, that at Newick Old Park, Waldron, "seams of fibrous coal, resembling that of Bovey," had been discovered, but the thickness and extent of the beds had not been correctly ascertained. Another account states that at Waldron a thin bed of "cannel coal" had been noticed on the banks of a rivulet which separates that parish from Heathfield, the seam being found to extend for a quarter

Since Mr. DAWSON'S Paper was written the Gas has been laid on to the Station and Waiting Rooms at Heathfield and has proved a great success. It has been analysed by S. A. WOODHEAD, Esq., B.Sc. (County Analyst for East Sussex), and its approximate composition is stated by him to be as follows:—

	Per Cent.
Oxygen	18·
Higher Hydrocarbons	5·5
Carbon Monoxide	4·0
Marsh Gas...	72·5
Total	100·0

may be indirectly traced to the same source. Numerous references to the occurrence of "naphtha" or "liquid bitumen," and even to emanations of natural gas, occur in the early numbers of the "Philosophical Transactions of the Royal Society." In the volume for 1684, is a paper by Dr. Robert Plot, in which he expresses the belief that the perpetual lamps said to be found alight in ancient tombs might be formed of a wick of "linum asbestinum," or "salamander wool,"—the material which we now call asbestos,—fed by a natural spring of naphtha such as that of Pitchford, in Shropshire, where, he says, "is a naphtha or liquid bitumen which constantly issues forth with a spring there, and floats on the water." This spring, which is still in existence, at one time (at the beginning of the century) had considerable celebrity, as the oil was distilled and sold as Betton's

latter beds contain dark leathery shales, which emit a strong odour of petroleum. But the Kimmeridge clays are specially characterised by indications of the oil, and their shales have been worked during past years in Dorsetshire, where petroleum has been obtained from them by distillation. The most interesting part of the problem is whether free petroleum may be met with at a lower depth. The experience in America is that the gas is first encountered, and the oil comes later on. The gas seeks to rise, and in so doing impregnates the rocks which lie above it. Let a free vent be given, and the gas rushes to the [illegible]

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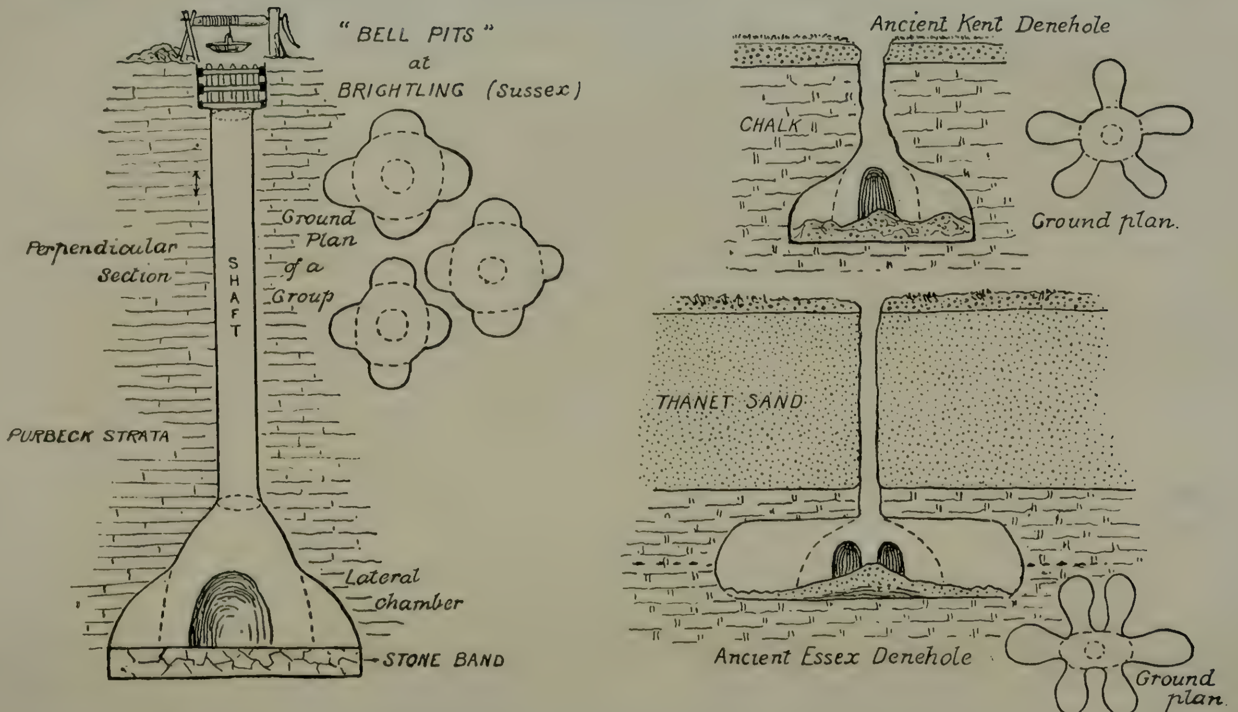
The existence of petroleum has been detected in this country at different times, especially in the West of England. Considerable interest was excited in 1894 by a discovery of this kind at Ashwick Court, in Somersetshire. If of no commercial importance, the matter is still one of the greatest historical interest, as the shale oil industry is the direct outcome of the distillation of a small outflow of petroleum at Alfreton, in Derbyshire, and the American petroleum industry itself, as will be shown later on, may be indirectly traced to the same source. Numerous references to the occurrence of "naphtha" or "liquid bitumen," and even to emanations of natural gas, occur in the early numbers of the "Philosophical Transactions of the Royal Society." In the volume for 1684, is a paper by Dr. Robert Plot, in which he expresses the belief that the perpetual lamps said to be found alight in ancient tombs might be formed of a wick of "linum asbestinum," or "salamander wool,"—the material which we now call asbestos,—fed by a natural spring of naphtha such as that of Pitchford, in Shropshire, where, he says, "is a naphtha or liquid bitumen which constantly issues forth with a spring there, and floats on the water." This spring, which is still in existence, at one time (at the beginning of the century) had considerable celebrity, as the oil was distilled and sold as Betton's

British oil, as a cure for sprains and rheumatism; indeed, it is one of the very earliest localities where pretroleum was distilled for commercial purposes.

Similar occurrences were noticed at Broseley, Bently, and other districts in Shropshire, and Camden's "Britannia" (1586-1607) described oil and gas springs at Fife, and at Formby and "Wiggin," in Lancashire, and the "boyling" of eggs by the burning gas, although the water through which the gas issued remained cold. Petroleum was found quite two hundred years ago at St. Catherine's Well in Liberton, and is still found at Longton, in Staffordshire, Coalbrookdale and Wellington, in Shropshire, at Worsley and West Leigh, in Lancashire, and in the neighbourhood of Bristol. In the Southgate Colliery, near Chesterfield, there is an intermittent flow of petroleum, amounting to from seventy to one hundred gallons daily. The most interesting occurrence of petroleum in this country is, however, one at Alfreton, in Derbyshire, where a small stream of oil flowing from a coal-working attracted the attention of Dr., now Lord, Playfair, and was, in 1847, distilled on a commercial scale by Dr. James Young, the father of the shale oil industry of Scotland. When this supply became exhausted, as soon happened, Dr. Young, believing that the oil had been produced naturally by the action of gentle heat on coal, commenced the experiments which resulted in 1850 in his celebrated patent for obtaining paraffin and paraffin oil from bituminous coal, and ultimately to the extension of this process to the bituminous shales of Scotland. Erroneous as were Dr. Young's premisses, the whole of the Scottish shale oil industry is the direct result of them, and the commencement of the American petroleum industry may also be traced to them. Shortly after the inception of the Scottish industry, a large number of establishments, working under royalties from Young's Company, were in existence in the United States, and by 1859 there were between fifty and sixty in existence. In that year, in the hope of obtaining larger quantities of the crude petroleum which was found superficially in many districts in Pennsylvania, and was then still believed to be a product of the natural distillation of coal, the celebrated "Drake" well was sunk at Tarentum, in Alleghany, and started the oil fever, of which the present position of the American petroleum industry is the outcome. The production of these immense quantities of oil without the cost of winning and distilling shale or coal, naturally struck the death-knell of the shale distilleries of the States, which, with the ready adaptability of the American people, were, however, at once converted into petroleum refineries, but the Scotch shale oil industry, although severely handicapped, has, so far, been able to eke out a precarious existence.



"BELL PITS"
at
BRIGHTLING (Sussex)
Ground Plan of a Group
Perpendicular Section
SHAFT
PURBECK STRATA
Lateral chamber
STONE BAND
Ancient Kent Denehole
CHALK
Ground plan.
THANET SAND
Ancient Essex Denehole
Ground plan.

REMARKS

ON

The Visit to the Bell Pits (or Dene Holes) at Brightling, Sussex,

BY

MR. C. DAWSON, F.G.S., F.S.A.

THE method of bell-pit mining, as practised at Brightling, Sussex, is one of the earliest forms of mining in the world. It is mentioned by Pliny as existing in Britain at the commencement of the Christian era. At Brightling the system is exemplified by the sinking of narrow shafts (three to four feet in diameter) to a distance varying from twenty to sixty feet; the object being to obtain the limestone known as the Purbeck "Greys" and "Blues" for road metal. The peculiarity of these pits is that, after having dug out a bell-shaped cavity at the bottom of the shaft of *such diameter as the pit-man considers safe*, and the limestone has been extracted, the whole excavation and shaft is abandoned, and a fresh one commenced within a few feet away; but care is taken that the new excavation shall be disconnected from the old one. The science of mining by timbered and propped sides is imperfectly understood. This system of mining was largely adopted at one time throughout England, and nearly always in chalk districts, where the chalk lay a small distance from the surface, and where it was required for manure. Even where the chalk crops out upon the surface, within a mile away, it was found cheaper, in the last century, to dig the chalk for use as manure in this manner rather than cart it, because carting necessitated the maintenance of a team of horses, vehicles, and labour, disproportionate to the amount of business carried on by many farmers. The chalk manuring was carried out from bell-pits, sixty loads per acre, for the sum of thirty-five shillings, all expenses included. In more ancient times the expense and labour would have rendered a system of carting altogether beyond the means of the richest farmer, except where water carriage was possible. In some counties the old

system of bell-pit mining for chalk is still in use, but in others, such as Essex and Kent, it is altogether forgotten. In those counties where the practice is still carried out or remembered these excavations are known as "chalk wells" or bell-pits; in other counties where the system has been abandoned and forgotten, they are not unfrequently called "Dane holes," for the simple reason, as many archæologists have observed, that the English peasantry are in the habit of attributing any mysterious excavations and ruins to the agency of the Danes, and especially anything relating to calamity. Thus the "Dene" or "Dane holes" are locally pointed out as being old hiding places and receptacles for storage of crops in time of danger, for which they are obviously most unsuitable. It is marvellous that in one county the system should be carried forward in all its old efficiency, while in others the results of the self-same system should be involved in a romantic haze, arising from ignorance of the original use of these excavations. It is curious that although the excavated chalk had been removed and laid on the neighbouring field for manure, that the very absence of chalk should have been attributed to the desire of the persons who were supposed to have inhabited these dwellings to conceal the site of the entrances of the shafts. So deeply imbued were the supporters of these theories that it seemed in vain to reiterate that there is no evidence of any habitation, and that the absence of chalk *débris* is the best evidence of their having been used for chalk-pits according to a past and present custom. The concentration of a few groups of pits in Essex is by no means unusual; in fact, all ancient writers agree that large tracts of ground were honeycombed for the purpose, and so dangerous was their vicinity that woods grew up and flourished around them. Respecting the alleged beauty of design and finish of the Essex and Kent "Dene holes," it may at once be stated that such allegations are made up of gross exaggeration and misconception. Such of the flints at the sides of the walls of the excavation, which were pointed out to visitors as being carefully trimmed so no sharp points should injure people, are nothing more than bands of tabloid flints which have a naturally straight fracture, and break off with a slight blow flush with the excavated surface. The design of these pits are necessarily uniform and pillared both for safety as well as to prevent the encroachment of one pit upon another. Every mining engineer knows that, without some such regularity and system in design, waste and danger must accrue.

Nothing further need now be said. Mr. C. Roach Smith long ago animadverted on the fallacy of considering these excavations anything more than chalk pits *where other evidence does not exist* (and, so far, no evidence is forthcoming). It was left to the

author to produce crushing evidence from the writings of agricultural experts of the last century in support of Mr. Roach Smith's view (*vide* "Transactions of the South-East Union of Scientific Societies," 1898, and Mr. W. T. Vincent (President), *Proceedings Woolwich District Antiquarian Society*, 1898, with which Mr. T. V. Holmes's paper in the *Geological Magazine*, October, 1898, may be compared).

The writer's paper was accompanied by *accurate* diagrams, as a comparison with the original excavations has shown. The chalk workings, described by Mr. F. J. Bennett, appended to the Essex Denehold Report (Essex Field Club), must *not* be taken as being at all typical of the general form of "Bell-pits" or "Dene holes." The truth is that variation in form, depth, and size, apart from general design, has little to do with the question, and arise from the differences of soil, custom of working, and the age of these excavations.

THURSDAY, NOVEMBER 10TH, 1898.

Protection in Nature.

BY

COLONEL C. SWINHOE, M.A., F.L.S.

COLONEL SWINHOE explained his object as being the giving of a few notes collected from various authors and from personal investigations, rather than the reading of a strictly scientific paper. In so doing he aimed at getting people to make observations on a subject in which many further investigations are necessary and in which those who take it up will find a never-failing interest.

His interpretation of the phrase "protection in Nature" was the protection brought about in the course of ages through natural selection for the benefit and preservation of living creatures, and his intention was to show examples of protective resemblance, aggressive resemblance, and mimicry.

"Any observer of Nature," he said, "must often be struck with the fact of the extraordinary resemblance many animals bear to their surroundings. Wherever we go we find the insects

in the green grass and in the green leaves of a green colour, and those living in the sand of the colour of the sand, and so on throughout all orders of creation. By protective resemblance we mean the resemblance to their surroundings, which enables animals to pass unobserved by their enemies and so escape destruction. The cases of the hare, lemming, stoat, and many other animals in northern latitudes are excellent illustrations; these become white every winter and brown every summer. It is obvious that a brown hare in a snow-field would be a very conspicuous animal, and that the palest members of the species would be those that would escape destruction; and the next year the palest of the survivors; and so on from year to year and age to age until in time all would naturally become white as the snow through natural selection or the survival of the fittest. And the same reasoning as to white hares in brown heather will apply, until natural selection has brought it about that all these animals become white in winter and deeper coloured in summer. A very curious theory, and apparently a very accurate one, has lately been expounded by an American artist, Mr. Abbot H. Thayer, as to the reasons for the white breast and abdomen of so many birds and mammals; he says it is undoubtedly a protective quality. He has presented to the British Museum and to the Museums of Oxford and Cambridge models of a bird in duplicate, one coloured all brown, and the other brown above with white breast and abdomen. The former is dark and distinctive and a prominent object at a distance; the latter is ghost-like, not very distinct when quite close, and rapidly fades out of sight as you move away from it; the white beneath neutralises the shadow of the creature and thus makes it invisible, and makes it a beautiful example of protective resemblance, whereas the brown belly intensifies the dark colour."

Pictures of several species of a low order of life, notably insects and crabs, in which the resemblance of the animal to its surrounding conditions acted as a protection to it, were thrown on the screen. Then followed slides illustrative of the Lecturer's argument as to aggressive resemblance, where the colour of the creature, harmonising well with its surroundings, enabled it the more easily to come at its prey. Colonel Swinhoe was careful to point out that in many cases the similarity was doubtless both protective and aggressive. The second set of pictures included representations of the walking turtle and of certain fish.

As regarded Mimicry in Nature two theories were put forward. One, propounded by an entomologist named Bates in 1862, suggested that creatures specially appetising as food to their neighbours are protected by their resemblance to creatures of a noxious order in whose company they live. This extraordinary theory was advanced by Bates, who was a close observer,

as the numerous personal observations, more especially in the valley of the Amazon.

On all fours with it was the theory of Fritz Müller, also arrived at from much personal observation. This supposed that a common type of appearance among distasteful insects in the same locality acts as a common advertisement to enemies, so that the loss of life which must ensue during the time in which each generation of enemies is being educated to avoid the owners of a particular type of pattern and colouring, is shared between these species, instead of being borne by each of them independently; it is, in fact, a multiplication of protection. As might be expected, all, or nearly all, animals protected by their distastefulness, are brightly coloured and mostly of distinctive patterns. Professor Lloyd Morgan's and Mr. Finn's recent experiments, made independently in different parts of the world, prove that there is no inherited knowledge of suitability or unsuitability for food, but that everything of an appropriate size and at the right distance is pecked at and tasted by young birds; on the other hand, young birds are extremely quick in learning, and have very retentive memories. Furthermore, one unpleasant experience makes them suspicious of other things, and they remember well the appearance of the insect which gave them a disagreeable surprise.

What was true of birds was probably, said the Colonel, true of other animals as well.

As an illustration of Müller's theory, he exhibited a few groups of "distasteful butterflies," which were mimicked in appearance by others which might otherwise prove too appetising to live.

Moreover, from the various examples it appeared that females were more frequently defended than males, a fact rendered more desirable for them on account of their slower flight when laden with eggs, and of other disabilities of their sex.

In conclusion, Colonel Swinhoe pointed out that the theory of mimicry and of common warning colours was believed by scientists, not because we have demonstrative proof in a complete knowledge of the details of the struggle for existence,—it will be very long before we attain to this,—but for the same reasons that we believe in evolution, because the theory offers an intelligible explanation of a vast number of facts which are unexplained by any other theory as yet brought forward, and especially because it enables us to predict the existence of facts which can afterwards verify.

WEDNESDAY, NOVEMBER 23RD, 1898.

Telegraphy, with and without Wires,

BY

DR. J. A. FLEMING, F.R.S., &c.

BEFORE proceeding to the more sensational division of his subject, the Professor began by a little exposition of the method of telegraphing with wires, "and," he wisely observed, "I shall not venture to assume that those whom I address are experts in this matter." Next year, in the little town of Como, where he was born, will be celebrated the centenary of the discovery of the electric current by Volta, the wizard who dwelt at Pavia. A photograph of the present statue of Volta at Como was thrown upon the sheet, and due honour was done to the great names of Ampère, Joseph Henry, and Sturgeon. In shadow pantomime, through the medium of a powerful lantern, the phenomena of electro-magnetism were exhibited,—the phenomena upon which the whole apparatus used in the most elaborate telegraphy is founded. It is to Ersted that the credit belongs of finding out the fact which enabled these phenomena to be utilised. He it was who first noticed that the direction of a magnetic needle enclosed in an electric circuit is reversed by the reversal of the direction of the current. With the possibility of transmitting to a distance by means of the electric current these opposite indications of the needle, Dr. Fleming explained that the foundation of telegraphic communication was laid, because whenever you have two signs which are able to be repeated in varying alternation, you have the possibility of making a code. The whole operation of sending a telegraphic message in its elementary form was here shadowed on the screen. No one person, said the Doctor, could claim to have been the inventor of the telegraph, but it was first put into practical form in England by Wheatstone and Cook, who invented the "five-needle telegraph," *i.e.*, and instrument wherein the cumbrous code which had at first to be employed was simplified by the use as indicators of five separately controlled magnetic needles.

Then were dealt with the later elaborations of the "wire,"—the discovery of the fact that if a wire along which a current was to run were carried downward to the earth, the earth itself

would complete the circuit; the wonderful Morse printing telegraph; and the culminating improvement of the Hughes typewriting instrument, which flashes the message to its far destination at the moment the operator touches the magic keys. Before passing on to the marvels of "wireless" telegraphy, the Lecturer stayed to say a few words about submarine cables,—"the nervous system of the world," as he called them. The difficulty with long-distance cables was at first a commercial one. They cost a lot of money, and business men wanted to know at what rate they would deliver the messages sent over them. At long distances the effect of the current was very much lessened, and the problem of how to receive the messages was for some time a difficult one. Then, with admirable clearness, the Lecturer explained, by means of a diagram, Lord Kelvin's beautifully ingenious invention of the refracting galvanometer, in which the almost imperceptible oscillations of a tiny needle of watch-spring steel, enclosed in a circuit at the receiving end, are magnified and made readable to the operator by means of a strong ray of light thrown upon and again reflected from it. As a fitting climax to the description of telegraphy with wires, the facsimile of an Atlantic cable message as written by another of Lord Kelvin's machines was thrown on the sheet. "Upon the whole, it isn't worse than some persons' handwriting," commented the Lecturer on the weird lines that zigzagged across the paper.

The second part of the subject was opened by an eulogy of Faraday, "the father of modern electricity," who, in the early part of the century, used to go day by day to his laboratory, with the regularity of a business man to his office, to wrest from Nature the secrets of her magic. He it was who found out the secret of the induction coil, and that if a copper disc be revolved between the poles of a magnet a current of electricity is set up without any other aid,—a discovery which Dr. Fleming called the "great-grandfather of all modern dynamo machines." In 1865,—an important year in the history of electricity,—Clarke-Maxwell, a pupil of Faraday's, came first to the definite conclusion that electrical effects must be due to operations taking place in a medium filling all space, and that these operations consisted of wave-like movements in this medium, "ether," which were of a different order from those which are appreciated by our senses as light. A very beautiful illustration to explain the purely up-and-down vertical motion of the substance of waves was thrown on the sheet. It was now practically proved, said Dr. Fleming, that the medium whose existence we had to assume to explain the phenomena of light, and that which we assumed to explain electricity, was one and the same.

When an electrical spark was made in the air, the electrical effect was propagated in all directions,—it was practically making a splash in the ether, as a stone makes a splash in water, and sends out concentric circles radiating from the splash. The connection of this fact with the amazing phenomena of "wireless" telegraphy is, as he very clearly explained, immediate and all-important. One of the principal facts which the clever young Italian, Marconi, was the outcome of the researches of the German doctor Herz. It was found that if an electric circuit, part of which was enclosed in a glass tube, were interrupted in a special manner by a small space within the tube, the current would over-leap that space, and continue its action, while if this space were occupied by fine metal filings, the current was stopped. If, however, the ether waves from an electric spark fell upon this tube, the filings would become arranged, and, in some mysterious way that is not yet understood, the current would be re-established. Here was the secret of wireless telegraphy. For if this "coherer," as the tube with the filings was called, was connected with a bell battery so that when the current was established the bell would ring, and vice-versa, a method of signalling was at once established. By making electric sparks of long or short duration send their waves upon the coherer, long or short rings would be produced, which could be interpreted, as a sound alphabet, by the Morse code. In practice it was found that unless the battery creating the sparks were close to the coherer, a couple of long metal rods attached to the ends of the latter were absolutely essential, their effect being to seize a greater length of the electric wave, in a way comparable to that in which an ear trumpet gathers a greater length of sound waves for a deaf person. It was this discovery of the effect of the rods in rendering the receipt of signals possible at a distance that was Marconi's peculiar contribution to "wireless" telegraphy. Dr. Fleming had got a coherer and rods, and a battery upon the platform. He made a spark at one end, and the bell attached to the coherer instantly rang from no visible cause in the wierdest way. A smaller coherer was carried by the Lecturer's assistant all round the room, and the bell was rung by the waves sent out from sparks of the battery on the platform. It would make no difference, said Dr. Fleming, if they carried the coherer out into the Pavilion grounds, for "stone walls do not a prison make" for the ether waves. By means of high masts, with wires running from a cross piece at the top to the earth Signor Marconi had succeeded in sending a telegraphic message 34 miles through empty air. It was not really "wireless" telegraphy, for these wires on the masts were necessary, and the longer the perpendicular length of wire, the further could the

message be transmitted. A question that naturally arose was: how can such messages as these be differentiated, if you have a number of receiving stations? To this question, Dr. Fleming said, no satisfactory solution had yet been discovered. At the present stage, if everybody set up "wireless" telegraphy, all the messages would get sadly mixed up. It was a serious limitation, but with the few stations so far set up the difficulties had not arisen. Having thrown on the sheet a facsimile of a message received by himself through the air in this way, printed by attaching to the receiver the ordinary machine, he concluded by the remark that the most remarkable aspect of the subject was the proof given that space is not empty. Of all the inventions that had crowned the reign of Queen Victoria none was more remarkable than this of "wireless" telegraphy.

WEDNESDAY, DECEMBER 7TH, 1898.

Light-Holding Appliances from the Earliest Times,

BY

MR. EDWARD LOVETT.

THE LECTURER, having given much attention to this subject for many years, was enabled to illustrate his remarks by photographs taken from the large number of specimens in his possession. These he had collected from all parts of the world, and it was interesting to compare the forms of oil lamps from the Hebrides, the native tribes of the Himalayas, and from the interior of China. Although all served the same purpose and embodied the same principle for the supply of oil, &c., to the wick, it was interesting to observe how much the forms varied according to the locality, and what ingenious devices were adopted by different people to obtain the same result.

It is impossible to do justice to Mr. Lovett's interesting lecture without the illustrations which made it so attractive. Regarding the ancient rush-holder, of which some specimens that he showed were made of Sussex iron, Mr. Lovett explained the reason why it was called the "poor man."

Before this holder was invented labourers used to be hired to stand in farmhouses at night to hold the torch that gave light, thus making living candlesticks of themselves. When the holders were devised the name of the "poor-man" clung to them.

WEDNESDAY, JANUARY 11TH, 1899.

Microscopical Demonstration

(METHODS OF CUTTING AND MOUNTING),

BY

MR. D. E. CAUSH, L.D.S.

THURSDAY, FEBRUARY 16TH, 1899.

Spiders: their Work and their Wisdom,

BY

DR. DALLINGER, F.R.S., &c.

DR. DALLINGER commenced by admitting the prejudice against spiders, observing that the poor creature, rather than being an object for careful and sympathetic observation, generally inspired no feelings but those of loathing and disgust. These feelings were inculcated from the days of the nursery; the strong crushed the spider, the weak and the timid fled from it, and to the ignorant it was an object for repugnance and contempt. The cause of all this was to be summed up in two words, "Inherited prejudice." The prejudice was in no sense justified by facts. After this introduction, Dr. Dallinger went into the subject quite from the point of view of the scientific observer. Of the abundant folk-lore and superstitions that have grown around the spider, he mentioned only the Greek story of Arachne, the daughter of a Lydian dyer, and so skilful in spinning that she challenged the goddess Athene to a trial in the art. Arachne's work was so beautiful that the goddess, like any ordinary mortal, was filled with jealousy, and tore the embroidery to pieces. Poor Arachne hanged herself, and the goddess, smitten

with compunction, changed the rope into a thread and the maiden into a spider. And that was why spiders were, pre-eminently, the spinners.

With respect to the derivation of the name, Dr. Dallinger said that spider and spinster meant much the same thing, etymologically. Built expressly for the purpose of spinning, the spider was the most specialised creature known. He called her a creature because she was not an insect. An insect went through the larva and chrysalis stages, whereas a spider was always a spider. There were two groups of spiders, sedentary and wandering, the sedentary catching their prey by means of snares made with wonderful ingenuity, while the wandering variety, though beautiful weavers, did not make snares, and literally had no place of abode. Of the sedentary spiders, some wove their webs in a circular shape, some in lines, some in tubes, and some in tunnels. The wandering spiders were divided into those who walked sideways, like a crab, and those who leaped on their prey. By means of magic lantern slides, the majority so beautiful that they evoked spontaneous bursts of applause, the Lecturer gave illustrations of these various types. Particular interest centred in the tunnel spider, over which the Lecturer waxed quite enthusiastic. This creature dug a tunnel into the ground from six inches to two feet deep, and lined the sides with silk with perfect regularity. For a lid it wielded together some forty layers of silk and clay, and hinged it over the top of this funnel. When closed, the presence of the aperture could not be seen, so perfectly did the lid fit. To further secure the lid, the spider drilled holes in the sides, and, when attacked, drove its claws into these holes to act like bolts.

"Do these spiders think," asked the Lecturer? One might almost fancy they did; and, to emphasise the point, he told of a spider which, when leaping a chasm, or performing some other dangerous feat, fastens a thread to her starting point so that she might have a rope to hang by, and climb up again should she miss her footing.

With the aid of diagrams, Dr. Dallinger proceeded to explain, in the clearest way, the internal structure of the spider, and the process by which she spun her silk, a structure so marvellous in its elaborateness and perfection of details, as to put to the blush even the intricate machinery used in modern manufactures. It was a section of the lecture that might easily have become very dull, but, in Dr. Dallinger's hands, it was one of absorbing interest.

Even more fascinating was the detailed description of how a spider builds its web and the ingenuity and engineering knowledge it displays in overcoming difficulties. He described how, in bridging over an intervening space, it waits until a current of

air comes that will blow a thread in the direction required. As soon as the thread reaches its destination the spider pulls it tight,—"though," added Dr. Dallinger, "how it knows I cannot tell, for it is always looking the other way." Then it waits until the thread has hardened, and then proceeds to build a triangle underneath it. In this triangle it puts up its many sided web, connecting every angle with the centre, and filling up all spaces with closely set lines, moistened with gum. A peculiar fact mentioned by the Lecturer was that the spider understood the theory that in a vibrating cord there were nodes, certain points always at rest. It twanged its lines as soon as it covered them with gum, and the gum collected itself on each node in the form of spheres. So what man looked upon as a recent discovery the little spider had known for thousands of years. A feature of this section of the lecture was the way it was illustrated by slides representing the working spider in motion.

The relation of these facts brought Dr. Dallinger again to the question of whether the spider could think, and, to illustrate his belief that they must have something akin to reasoning power, he gave an instance that had come under his own notice. A spider by the sea found a gully where the wind always blew steadily one way, and it erected its web there. It was just as if it argued that, with such a decided current of air, it was likely that a goodly harvest of flies would be brought down. At the same time, it realised that such a strong current of air would speedily wreck the web, so it took pains to make the fundamental parts of the structure specially strong. It put in additional buttresses, and even ran skeins on the windward side from the web to the ground, strengthening the fabric in the particular way necessary with the skill of an engineer. How did the spider know that all these extra precautions were essential? Surely it argued a way out of the difficulty.

A striking way was chosen by the Lecturer to demonstrate the extreme thinness of a line in a spider's web. It was no good talking about the fraction of an inch, so he threw a picture of a line on the screen. Over that he threw a ruling of lines, drawn on the same scale, each a thousandth part of an inch apart. The difference between the spider's hair and a thousandth of an inch was as the difference between a thread of fine silk and a stout hawser!

Some people probably wondered what the spider lived for; was all this output of ingenuity simply for the degrading object of catching flies? He could not answer that question. But it must be remembered that all animals lived by preying upon others. Even the refined ladies and gentlemen before him suffered no qualm of conscience when eating a fowl or rabbit.

Oh! of course, it was very different. Perhaps so; the spider ate its food raw and we cooked it first. He was convinced that the spider pre-eminently ate to spin; many men spun to eat. There was no penetrating the mysteries of Nature; whether we searched the starry spheres with a telescope, or examined the spider with the microscope, we found the same omnipotent wisdom, the same infinity.

WEDNESDAY, FEBRUARY 22ND, 1899.

Pain,

BY

MR. G. MORGAN, F.R.C.S. ED., L.R.C.P.

TAKING up the consideration of a central nervous system consisting of brain and spinal cord, and of a sensory surface of skin, Mr. Morgan set himself to explain the connection between these two by means of the nerves, which are "practically the electric cables and the finer electric wires of the nervous system, conducting impulses to and from the tissues and organs on the one hand, and the nervous centres on the other." The "first essential" of a nervous fibre is "its axis cylinder or Axon, which is a cylindrical, or band-like, pale, transparent structure, which, after being treated by certain reagents, shows itself composed of very fine homogenous or more or less beaded *fibrillae*." This cylinder is enveloped in "its own hyaline sheath, the Axilemma." The next essential of the nerve fibre is an insulating material, surrounding the Axon as gutta-percha surrounds the copper of an electric wire. This insulator, which is "bright, fatty, and glistening," is called the medullary sheath, or white substance of Schwann." Outside the white substance of Schwann is the "Neurilemma," which forms the outer boundary of the nerve fibre.

Each nerve has its own blood vessels ramifying outside and within its sheath, giving off smaller vessels that supply the ultimate fibres. And it is through these small vessels that certain neuralgic pains are caused when the blood is loaded with the toxins of "malaria, or influenza, or other specific disease," or has been robbed to a certain extent of its oxygen-

earning properties. The blood is then brought into direct contact with the small fibres, and the result is—pain.

When the various electric cables, or nerves of the body, reach the spinal cord, they divide into two parts. Those which give the power of movement pass to the front of the cord, while those which convey sensation enter the back part of the cord. Sensory impulses, or "feelings," from the right side of the body pass up the left side of the cord, and those from the left of the body pass up the right.

The rate at which "painful impressions" may travel from the skin along the nerves of feeling to the brain is estimated to be about the same as the rate at which the power of action passes down the "motor" nerves when communicated from the brain to the muscles. The actual speed at any given time is believed to vary according to temperature, and other circumstances which cannot be easily defined. It may sink as low as 30 miles per second if the limb concerned is cold, or if the limb is heated it may rise as high as 89 miles per second.

Not a few have tried their hand at defining pain, and explaining the reason of its existence. Pathologists, theologians, and philosophers have all spoken, and have found some kind of an audience to listen to them. The pathologist says, "Pain is the sign of diminished functional activity,"—which is prosaic. The theologian says, "Pain is the penalty of some broken law." There is truth in the statement, but it is not the whole truth, and nothing but the truth. The philosopher, "who has some poetry in his make-up," says "Pain is the prayer of the nerves for blood." Another definition, which Mr. Morgan thought would recommend itself as "simple and suggestive," and as emphasising the truth that pain is not an unmixed evil, is, "Pain is the protector of the voiceless tissues." Pain is not in many cases simply revenge for broken law, but its first object is remedial. Of this the Lecturer gave a number of examples. Among other things he said that chilliness, which is a species of "painful impression," makes people walk faster, or draw near a fire, and so ward off a cold or something worse ; or it may cause a sneeze, which is Nature's attempt at arousing the nerve centres.

But pain frequently passes beyond this beneficent stage as a warning voice, and becomes a positive danger by its presence. If it is really acute and continuous the general health suffers. Indeed, it may be so acute as to cause fatal collapse, especially if the heart is not sound. The organs of the body are capable of becoming the seat of pain with different facility. No doubt those nerves specially regarded as nerves of sensation are generally those which conduct pain, but true sensations of pain can be conducted through the nerves of special sense, such as sight, hearing, &c., by increasing their specific energy.

In particular it happens in the case of the eye and of the ear, that intense light and loud and grating sounds produce sensations which we speak of as paining the eye and ear. Pain, therefore, has no specific quality.

With the feeling of pain there may be mingled a localised impression by which we are to some extent capable of deducing the cause and nature of the pain. We can tell a burn from a pin-prick, or a cut from pressure, and by the same apparatus we can characterise the various pains that occur in disease as "burning," "tearing," "stabbing," &c.

Persons who are half ashamed of their cowardice in bearing pain may take heart of grace. For "there is not the least doubt that some are far more sensitive to pain than others." Their nerves are more easily impressed, and pain is more quickly produced in them than in others. As a rule females suffer more than males. There is a state known to the learned as *hyperæsthesia*, in which certain nerves, such as those of taste or smell, are rendered extraordinarily sensitive. One can see illustrations of *hyperæsthesia* even in North-street, when the brake of a descending omnibus is unusually active, and one can observe the marked difference in the effect which the noise has upon different occupants. The children as a rule enjoy it as a pleasant diversion, some of the occupants may be unaffected, while others will be tortured almost beyond endurance.

Dentists, too, notice the marked difference in patients as to the amount of pain they suffer. Mr. Morgan thought it is sometimes wrongly expressed when we say that some "bear" pain better than others. It may be a fact that they do, but it is equally a fact that some do not feel the pain as acutely as others.

The fact that the disease or injury is not always at the same spot as the pain may be surprising. There is frequently such a thing as "reflected" or "sympathetic" pain. A familiar example is to be found in the case of a blow to the "funny" bone, otherwise the "internal condyle of the humerus." When the bone is struck the tingling sensation is not felt at the seat of the injury, but is "reflected" to the terminal distribution of the nerve in the little finger. The same sensation is felt if the outside of the leg a little below the knee be knocked, when the tingling will be "reflected" to the toes. (These facts may be experimentally verified if desired.)

A number of other cases of "reflected" pain were adduced, and Mr. Morgan said that just as pain could be induced by reflex action, so it could be subdued. One other very curious fact alluded to was that of *pseudæsthesia*, or false pain. A clergyman the Lecturer knew had his leg amputated after a severe injury, and had a cork leg. He had had bad corns on his original leg, and naturally thought he had felt the last of them. Not so.

As the reverend gentleman stumped to Church he was constantly in pain as if from the corns on his vanished leg, and for years afterwards, as he lay in his bed with his cork leg on a table hard by, he would start with a sudden twinge of pain, as if from his corns. This was by no means a singular case, though a severe one. A little girl who had had an amputation at the forearm said, "My fingers hurt me, nurse, especially the little finger." The explanation of this singular phenomenon lies in the fact that each fibre of sensory nerve comes from a certain part of skin, bone, or tissue, and is the special conductor for that part and no other. After an amputation the continuations of the nerve fibres from the amputated limb are still present, and if irritated send an impulse to the brain, which is registered as if coming from the original part. But this false pain does not continue indefinitely. The nerve fibres coming from the amputated member eventually atrophy, though how soon or how late it is impossible to say. The seat of pain, physical and mental, is the brain, and any part having no longer any connection with that organ is no longer subject to pain.

Whether or no physical pain is more or less common than it was fifty years ago it would be difficult to say. Mr. Morgan was inclined to take the more hopeful view. But he felt there could be no doubt that mind pain, or *phrenalgia*, is a far more serious enemy to-day than it was years ago. "It is to-day what biliousness was half a century ago, and is due, like the old biliousness, to reckless living, though in a different form. The hurry and bustle of life, the high speed and pressure, the severe competition which too often demands that the whole of a man's energies shall be sacrificed at the altar of business or professional life, crowded out digestion, sleep, and all such trifles. And then what? At fifty or sixty a man has money, but no capacity for enjoying it wisely. And then, when the stimulus that came from an over-busy life is suddenly taken away, the brain atrophies from want of stimulus, and the poor man becomes a prey to *phrenalgia*.

MONDAY, MARCH 13TH.

The Skin of Liquids,

BY

C. H. DRAPER, B.A., D.Sc. (LOND.),

Municipal School of Science and Technology.

AS is the case with most of the deeper facts of physical science, in dealing with the "skin of liquids" we are dealing with something which is itself invisible. You cannot skin a mass of water as you can a hare, and hold up the skin *in omnium conspectu*. But its existence may be proved by means of a delicate little instrument devised by a physicist named Mensbrugghe. Take a piece of cork, affix a ring of thin wire to one end, and a weight to the other. Adjust the weight so that the apparatus floats upright in water with the ring just above the surface. Then take a small rod, and gently push the whole device down under the water. Experience ought lead one to suppose that on taking away the rod, the float would return to its first position. If, however, the float be carefully balanced so that the wire ring, on being allowed to rise gradually, touches the surface all round at the same time, the apparatus will rise no higher,—showing that the film of water at the surface offers more resistance to the passage of a solid body than either the water below or the air above.

A second experiment brings home the existence of the "skin" in a more striking way. "Here we have a sieve with very small meshes," said Dr. Draper, "and if water be poured carefully into it, the water does not run through, because the skin formed between the meshes blocks up the small holes. You remember the people who, in the days of our childhood, when nothing was impossible, went to sea in a sieve? Well, I should not mind going to sea now in a sieve, if I were allowed to make the sieve, and have full command of the weather. Here is a small sieve made of copper, which is nine times as heavy as water, yet this sieve might be warranted to carry a small burden on smooth water. It is, in fact, a boat floating with 10,000 holes in the bottom—the more holes the better for the boat."

The next thing he showed was a bowl containing wires, darning needles, and such-like articles, composed of metal seven or eight times as heavy as water, all floating about as happy as could be. Nevertheless, it is easier in some respects to launch a torpedo-destroyer than a darning needle. The best method is to grease it slightly, take it tenderly on the prongs of a fork—the needle, not the torpedo-destroyer—and lower it gently, keeping it perfectly horizontal.

After a reference to the familiar spectacle of water-flies skimming the surface of a pool, Dr. Draper came to another illustration of his subject. If a sheet of muslin be carefully stretched over a ring held horizontally and water be gently placed upon it, by means of a pipette or syringe, a large flattened drop may be obtained on the muslin without any of the water passing through. The surface film touches the muslin, which is not really wetted by the water. And so long as the skin remains unbroken the water does not pass through, and the muslin remains dry. If once the skin be broken the threads of muslin become wet and the drop or part of it passes to the under surface of the muslin, and if the drop there formed be too heavy it falls off, and so a stream is started which will carry nearly all the water away. In this case the water does not, however, all escape; there is a skin above the muslin and another forms below, and a quantity of water is held imprisoned between them. People who live in tents in rainy weather often have decided experience of these matters. When a steady rain falls on canvas it does not at first make its way through. A film spreads all over the material, and so long as this skin remains unbroken all the interstices between the material are filled up and no wet gets through. But the slightest touch at any spot brings the film through to the inside, and then the water will run through as though a hole were cut in the canvas. The use of umbrellas is based on the same principle, and their effectiveness is limited in the same way.

Though all liquids have films of this kind, yet all the films are not of the same strength. Ether, for instance, and alcohol, are much more "thin-skinned." If Mensbrugghe's float be submerged as already described in water, and ether or alcohol be allowed to become mixed with the water, the float immediately breaks its way through. The surface tension of water is greater than that of any other liquid except mercury.

Dr. Draper then described a number of experiments devised to show other properties possessed by the "skin" besides that of resistance to penetration. The most characteristic of these is its contractility, which may be observed in many different ways. A good method is to suspend one lucifer match horizontally from another by means of a thread at each end,

the threads being of such a length that the two matches form the upper and lower lines of a square perpendicular plane. If this be dipped into some soapy water it will come out bringing a film of water with it, covering it like the skin of a drum. But instead of the threads hanging vertically as they did before immersion, they are curved inwards, and the bottom match is raised up, showing that the surface film is exercising a pull and endeavouring to contract. If the film be broken the lower bar falls. The whole film consists of two skins with a layer of water between them. The film is thus seen to behave like a piece of stretched indiarubber, which is always trying to contract, but it differs from stretched indiarubber in one respect. With the stretched rubber the tendency to contract is different according to how much it is stretched, while with a liquid film the tendency to contract is always the same at the same temperature, however much or little it may be stretched. Such films as the above are plane surfaces, but liquid films may be also cylindrical or spherical. A cylindrical film is easily obtained by placing two wet wire rings in contact with each other, and lifting the top one. If the bottom ring were not too heavy, the contractile force of the cylindrical film would lift it up. The power of this contractile force may be vividly manifested in another manner. If two plates of glass six inches square have a film of water between them in this way 1-200th in. thick, they are pulled together with a force about equal to the weight of six pounds. Spherical films are seen in the case of falling drops of liquid, partially spherical films in the case of drops resting on a solid surface, where they are acted on by their surface tension, tending to make them perfect spheres, and the force of gravity tending to flatten them out.

An interesting explanation was that which Dr. Draper gave of the effect of throwing a suitable kind of oil upon water to calm it. Water being so much "thicker-skinned" than oil, the latter, when cast upon it, immediately spreads out over the water until the layer of oil gets so thin that it ceases to behave like liquid oil at all. To this fact must be added that already alluded to in the float experiment, that any other liquid mixed with water lowers the resistance which the "skin" of the water offers to breaking. Suppose, then, a ship to be surrounded by a layer of oil. The waves come rolling along towards it, reach the distant edge of the oil film, there suddenly experience a lessening of the tension of the surface, and break there accordingly. The main swell of the wave rolls on, but the ship is in the middle of a ring of breakers, which surround it at the outer boundaries of the film of oil.

"On to a flat plate," said Dr. Draper, "we pour a thin layer of coloured water, about 1-10th or 1-8th inch thick. On

this water we place a little alcohol. Immediately the water rushes away and stands round in a circular ridge like a hollow crater! It leaves the middle almost, if not entirely, bare of liquid, save that some of the alcohol at least will not take part in the flight. The tension of the pure alcohol is 25, while that of pure water is 81. Hence the surface film is set in motion from the alcohol towards the water all round, and motion ensues of so energetic a character as to leave a bare place where the drop of alcohol was put. A dimple may be formed on the surface of water by holding a brush or small sponge dipped in ether or alcohol just above the water surface. This retreat of water from the presence of alcohol, which I am treating as a physical fact with no moral significance, may be observed in an ordinary tumbler. If in the middle of the surface of a glass of water a small quantity of alcohol be gently introduced a rapid rush of the surface occurs outwards from the place where the spirit is introduced. If the sides of the glass be wet with water above the level of the surface, and the spirit be introduced in sufficient quantity, the fluid may be seen to ascend the sides of the glass, accumulate in certain places, and fall down again into the mass of the liquid. Wine contains alcohol and water, and when it is exposed to air the alcohol evaporates faster than the water. In a deep vessel like a wine glass, this produces little effect at first in the mass of the wine, but a good deal in the thin layer of wine which, if the glass be disturbed, exists on the sides of the glass above the liquid surface; tension being greater in the most watery parts, it pulls itself literally together away from the alcoholic parts where the tension is less. These ridges flow down the sides by their own weight. As they slide down they may sometimes be seen to stop and retreat when they come into contact with the alcohol. So the process goes on until in time there is very little alcohol left in the wine glass."

The surface tension of liquids is lowered as their temperature rises, until, at their boiling point, it is reduced to *nil*, and they are reduced to vapour. If 100 drops of water be collected from the hot-water tap, and 100 drops from the cold, it will be found that the amount of water obtained from the cold tap exceeds the amount from the hot tap, the reason being that the hot films break more quickly, not being able to support such large drops.

A little practical application of the laws of surface tension is useful in getting rid of drops of oil from clothing. If a ring of turpentine, ether, or benzol, whose surface tension is very low, be made round the grease spot, the grease immediately retreats on to its centre, where it may be absorbed by blotting paper. Or the grease spot may be "chased about" by threatening it with a

hot poker. If the hot poker be applied to one side of the cloth, and blotting paper be applied to the other, the grease, in its hurry to get away from the poker, is driven into the paper.

The curious phenomenon of "capillary attraction" was also dealt with by the lecturer as one of the effects of surface tension. When the ends of fine tubes are immersed in liquid, the contractile force of the surface film pulls the water up the tubes, he said, to a height inversely proportional to the diameter of the tube. Soap bubbles, ripples on a liquid surface, the effect of electricity on the "skins" of liquids, and finally the minute thickness of these "skins" were among the other matters which Dr. Draper spoke about. It appeared that the thickness of the subject of his paper was no greater than between 1—100,000th and one millionth part of an inch. "Somewhere about here," he concluded, "we reach the limits of physical divisibility, and also of my remarks."

WEDNESDAY, APRIL 26TH, 1899.

Röntgen Rays as an Aid to Scientific Investigation,

BY

MR. E. PAYNE, M.A.

MR. PAYNE first gave a short description of the discovery of the X-rays by Professor Röntgen at Würzburg in November, 1895, reminding the audience that the subject had already been treated at a previous meeting of the Society soon after the discovery.

He pointed out that there were two methods of using the rays in scientific investigations: 1, by the aid of the phenomenon of fluorescence; 2, by the use of the photographic plate.

Different substances become fluorescent when the X-rays fell upon them, one of the best for practical use being platino-cyanide of barium, fine crystals of which were spread upon a

sheet of vellum, mounted on a frame, so as to form a "fluorescent screen."

Substances placed between this screen and a focus tube emitting X-rays cast shadows, the density of which would depend upon the thickness of the object and upon its permeability to the rays. When permanent results were required a photographic plate was used. This was placed in a light-tight bag or holder, made of paper or other substance permeable to the rays, which then acted on the sensitized film after passing through the paper, &c. The plate thus gave a permanent record of the shadows which might be seen on a fluorescent screen, the effect on the plate depending upon the permeability of the different parts of the object placed between the plate and the tube.

The permeability of a substance to X-rays differed from its transparency to ordinary light. Glass, for instance, was somewhat opaque to the X-rays; while diamonds were transparent or permeable. The metals were on the whole opaque, aluminium being the most transparent. Vegetable substances were transparent to the rays. A metal object, placed in a wooden box, would, therefore, give a shadow on the screen. Bone, owing to the lime salts contained in it, was more opaque or less permeable than flesh; for this reason it was possible to obtain shadows of the bones of men and animals through the flesh and skin. This fact had led to the use of the rays for medical and surgical purposes, and constituted the most important application of the rays, as it enabled us to make investigations in the living body which had never been possible before. Each substance had, therefore, its particular or specific permeability to the X-rays, as it had a specific resistance to a current of electricity, or a specific gravity or conductivity for heat. And the fact that this permeability was different for different substances enabled us to make use of the rays for scientific investigations; we could study the internal structure of a body, or measure and localize hidden objects.

The Lecturer then showed a number of lantern slides to illustrate the applications already described. These consisted mostly of photographs of X-ray pictures of shells and animals and other radiographs taken for surgical purposes. A picture of a large shell of the nautilus type showed the internal structure with the successive divisions built by the animal as it grew. Another picture, of a rat, showed all the bones in every detail. The gradual growth of the bones was illustrated by a slide showing three elbows taken from children of different ages with one of an adult for comparison. This illustrated the use of the rays for the study of the growth of the bones in men and animals. The way in which bones are broken was illustrated by a slide showing three radiographs of fractures of the femur, taken at the Children's Hospital. A large number of prints from plates

were exhibited illustrating the use of the rays for showing diseases of the bones, such as necrosis, periostitis, and tuberculosis, also hip disease. There were also some radiographs of the lungs, showing cavities and thickening in the lung tissues.

The Lecturer then explained the methods of measurement and localization. This is done by taking two or more radiographs from different points of view, and noting accurately the position of the tube with regard to the body containing the hidden object. By constructing a figure with lines showing the path of the rays, the size and position of the hidden objects can be readily shown. These methods are used for the localization of needles, shots, &c., in the hands and feet, and, where necessary, for stones in the kidneys.

Some stereoscopic pictures were shown at the conclusion of the lecture, by the aid of some Wheatstone stereoscopes. These included radiographs of a rat, and of a mole, giving the appearance of a solid body of transparent material, through which the structure of the skeleton could be distinctly seen. Similar effects were given by radiographs of some shells. As illustrating the possible application of the rays for botanical investigation, radiographs of some nuts were exhibited, showing some with unsound kernels, some without any, or with only imperfectly developed kernels.

WEDNESDAY, MAY 10TH, 1899.

Before and After Newton,

BY

MR. HENRY DAVEY, JUN.

AT the outset Mr. Davey made allusion to Darwin's theory of evolution as compared with Newton's theory of gravitation, but without discussing the respective importance of the two theories, or the priority in genius of the two philosophers, turned to the contemplation of the prodigious change effected in thought by the labours of Sir Isaac Newton, "who at the age of 45 published the greatest of all scientific works, and then lived 40 years longer without producing anything of special importance."

Newton himself was a man of absolutely unsurpassed genius for Science, though several points in his life are at least questionable. He was engaged in a good many serious quarrels; and from his early life constantly made discoveries which he did not publish to the world. De Morgan justly said that first Newton made a discovery, and next the world had to discover that Newton had discovered it; and the latter part of the process was the longer and more difficult. Most fortunately Newton had a friend in Halley, who with singular tact recognised and fulfilled the task of preventing Newton's genius from being wasted, at least, till the publication of his *magnum opus*. The stupendous results which Newton achieved were owing to his possession of a mind equally adapted for induction and deduction, and to his faculty of *guessing* correct results and then spending years of patient toil in irrefragably proving his guesses. Buckle says that only Aristotle and Newton have shown themselves able to reason with absolute accuracy both inductively and deductively; and elsewhere, that no poet, except Dante and Shakespeare, possessed so soaring and audacious an imagination as Sir Isaac Newton.

Newton was born on Christmas Day, 1642. His youth and early manhood were passed in his native Lincolnshire and at Cambridge University. What was the state of Science then? It was a very great period, politically, for then occurred the Civil War, the execution of the King, the establishment of a Commonwealth, the military rule of a Huntingdonshire squire, and, finally, the Restoration of the Monarchy and the Episcopalian Church. All this upheaving and unsettling of ancient convictions and habits had produced a general ferment in Englishmen's minds, and the greater part of the nation had finally become zealous for nothing in politics and religion, and were ready to turn to any other interesting pursuit. Already during Newton's infancy a number of men were in the habit of meeting to discuss scientific questions in London, and during the Commonwealth at Oxford. After the Restoration they were incorporated and chartered under the name of the Royal Society.

Mr. Davey passed on to point out that it was Lord Bacon who was the first "to make Science respectable." That a Lord Chancellor should write an elaborate work in the grandest style, recommending the cultivation of Science, was a complete novelty; and though the writer was by no means abreast of the Science of his own day, and had little effect in his lifetime, yet a generation afterwards his philosophy was of the deepest influence, and made Science not only respectable, but even, for some time, a fashionable pursuit, which even Charles II. and his courtiers delighted in practising. It was now felt that unknown possibilities lay hid in the world of Nature, and everyone expected results rather too rapidly. There were still here and

there a few old-fashioned men unleavened by the Baconian spirit; and one Shropshire clergyman wrote a tract to denounce the Royal Society's making experiments in new directions, instead of studying the wise ancients. Nor were there wanting those who supposed the study of natural history to be irreligious; but the adhesion of several Bishops and the direct patronage of the King soon destroyed this belief. What was objected to was not the study of natural history in itself, but the original researches made, and the avowed intentions of discovering novelties. The objectors were, however, few, and soon heard of no more, and the romantic dream of Bacon, embodied in his "New Atlantis," was, in effect, realised. There was in England a Solomon's House, with Merchants of Light, Depredators, Lamps, and Pioneers, endeavouring to discover the secrets of Nature, and make them of practical advantage. Also they understood their task much better than Bacon did. What seems so obvious to us was a romantic dream in Bacon's days, and to his contemporaries it must have seemed childishly trivial; the maintenance of scientific experimenters and discoverers would to them have been not only a dream, but they could not have realised the advantages of such a course. The popularity of Bacon's philosophical works had changed men's minds, had made the Royal Society possible and successful.

Giving an account of the state which Science had attained at the time of Newton's first discoveries, Mr. Davey said that Copernicus had published his argument for the earth's motion in a circle round the sun in 1543; but scarcely any declared themselves convinced for a hundred years. Kepler had shown that the orbit was not circular, but elliptic; and Galileo, by using the newly-invented telescope, had found that Jupiter had satellites, the moon an uneven surface, and Venus phases. Many denied the existence of such novelties; one young man had seen spots in the sun, but his superior reproved him, saying, "I have read the works of Aristotle for many years, but never found any mention of spots in the sun; the spots must have been in your own eyes." Others said they had looked for hours through Galileo's glasses, but saw nothing of his new stars or other discoveries. Such absurdity could obviously not last long. Other students here and there began to follow Copernicus, Kepler, and Galileo in appreciating the arguments for the earth's motion; and by the middle of the 17th century the question was settled in the minds of scientific men. In this same 120 years, a very large increase had been made in the domain of mathematics. Two great inventions, Napier's logarithms and Descartes's algebraic geometry, had enlarged the Science; and various attempts had been made to calculate curves, with which no progress had been made since Archimedes and Appollonius. Cavalieri, Fermat,

Pascal, and Wallis had glimpses of a new method of calculating. Galileo had made discoveries in applied mathematics far more important than his astronomical discoveries, which anyone with a telescope could see. He had formulated two laws of motion, the principle of virtual velocities, the law of acceleration of falling bodies, the parabolic path of a projectile, and the isochronism of pendular vibrations. Soon after Galileo's death, England, stimulated by Bacon's works, took the lead in experimental philosophy.

As yet no connected ideas upon the constitution of the universe had been evolved by the new Science. The old Ptolemaic system, now overthrown, was at least complete. Ptolemy has placed the earth in the centre of the universe; eight crystalline spheres surround it like the balls of a Chinese puzzle, containing successively the Moon, Mercury, Venus, the Sun, Mars, Jupiter, Saturn, and the fixed stars. All these spheres continually revolved with incredible swiftness round the earth; and since they were all perfect, their motions took place in the most perfect figure, a circle.

This system, however, found a severe stumbling-block in the apparent irregularities that could be observed, owing to the complex and looped paths of the planets among the fixed stars; and additions of cycles, epicycles, and deferents were brought in explanation. This caused King Alphonso to say that if he had been consulted at the creation of the world he would have suggested several great improvements. Kepler supposed that the solar system was shaped like a wheel, each planet being on one of the spokes, and having an angel to push it.

So, when Newton began his career, a new mathematics was required for calculation, and a new system of the world was required to take the place of the Ptolemaic, which was at least consistent and complete, however false and clumsy. Newton produced both the new tools and the new results. After mastering all that was known of mathematics in his time, Newton, in 1665, produced that extraordinary weapon of Science, the infinitesimal calculus. But he did not publish it, and thus got into a very unpleasant controversy thirty years later. The advantages of this discovery were discussed at length.

The familiar story of the fall of the apple that led to the working out on such a tremendous scale of the principle of gravitation then came under the Lecturer's attention. Gravitation was known to exist on the tops of mountains, and at the bottoms of mines, and at every spot on the surface of the earth. Newton thought within himself, "Does it extend beyond the earth?" The ancient idea was that the centre of the earth attracted all heavy substances to it. This idea we find enunciated in Shakespeare's *Troilus and Cressida*, and in detail at the end of

Dante's *Inferno*, where the poet describes himself, under the guidance of Virgil, as reaching the exact centre where Satan is confined, then turning round, and climbing till he emerged at the Antipodes. The investigations of Galileo had shown that all bodies, apart from the resistance of the air, fall at exactly the same pace towards the centre of the earth, 16 feet in the first second. To generalise this fact beyond the earth was a guess, Newton's most wonderful guess; "anyone may make guesses at scientific results, but to guess correctly and prove the correctness is the work of genius only." Mr. Davey set out how Newton calculated the orbit of the moon, and to his great disappointment, found the fall towards the earth to amount to 13 feet instead of 16. He laid aside the subject for years in consequence, but accidentally heard at a meeting of the Royal Society that a fresh measurement of the earth had been made by Picard, who found that a degree of arc measured 69 miles instead of 60, as had been previously supposed. Then Newton returned to his labour, proved the truth of his guess, and showed that gravitation affected not only the earth, but was the force that held together the entire solar system. Newton also showed that the effect of gravitation would be to flatten the earth at the poles, to occasion the precession of the equinoxes and the phenomena of the tides; and that the masses of the heavenly bodies might be computed by it. Yet, however, these results might never have been published had it not been for Newton's friend, Halley, who himself brought the matter before the Royal Society, and paid the expense of printing the book.

The title of the work, which finally came before the world in 1687, was *Philosophiæ Naturalis Principia Mathematica*,—Mathematical Principles of Natural Philosophy. It is commonly called the *Principia*. The very title of the work marked out its fundamental difference from all previous systems of the world. It was a mathematical attempt to explain the constitution of the universe.

In the first book of the *Principia* Newton showed mathematically what laws would result if bodies attracted each other by gravitation. The method is that of the ancient Synthetic Geometry; definitions and axioms are laid down, and successive theories and problems are solved. The most extraordinary portion is the wonderful sixty-sixth proposition, with its twenty-two corollaries. In the second book the method of fluxions (the calculus) is laid down; but Leibnitz had already published his form of the calculus. Finally, the third book, by the aid of the new mathematics, shows that all the known solar system actually does follow the laws which had been shown in the first book to rule if bodies attracted each other by gravitation. The demonstration was as complete as it could be made by human

means, and the poem which Halley prefixed concluded: "Nec fas est mortalibus propius attingere divos." (It is not lawful for mortals to approach the gods more nearly.)

"What progress has been made since Newton's time in our knowledge of the universe?" asked Mr. Davey. He answered by pointing out the development of the infinitesimal calculus by continental workers and the discovery of the differential equations of gravitational attraction. Except for this, and attempts to solve such equations, absolutely no discovery in gravitation had been made since Newton's time. The difficulty of computing the mutual attractions of three gravitating bodies is not yet absolutely overcome. If we had observations upon multiple stars, the problem would have to be faced in all its rigour. The principal need for advances in mathematics at present seems to be further progress in the solution of differential equations; but probably an entirely new branch of analysis will have to be invented before this advance was of definite advantage. So thorough and complete is Newton's work.

In a concluding summary, Mr. Davey said that the rise of modern Science in the 16th century was considerably impeded by false views of what was desirable to study; that, as far as the generality of thinkers was concerned, the nobility of natural Science was first made known by the writings of Francis Bacon, the Lord Chancellor, Court favourite, and Statesman who thought it not undignified to experiment, nay, even that the study of natural Science was the most important of secular employments. After his death, and during the political turmoil, Englishman after Englishman turned to the path whither Bacon had pointed, and finally the novel materials, quickly accumulated, were employed by a man of the highest genius, whose originality, in the words of his greatest successor, Laplace, "will assure to the *Principia* a pre-eminence above all the other productions of the human intellect."

WEDNESDAY, JUNE 14TH, 1899.

Annual General Meeting.

REPORT OF THE COUNCIL

FOR THE YEAR ENDING JUNE 14TH, 1899.

The Council has much pleasure in congratulating the Members on the continued prosperity of the Society, as shown not only by the membership being well maintained, but also on the admirable series of Papers and Lectures read or given before it during the past year. It is, however, matter for regret that the Lecture scheme to which allusion was made in the last Report did not receive from the public that support which would justify the continuance of the Lectures. In consequence, some loss has fallen on the Guarantors. The programme of Papers and Lectures for the Session 1898-9, which was circulated at the commencement of the Session, has been carried out in its entirety. It is hoped that the practice thus begun of publishing a programme will be continued. Two of the delegates appointed to attend the Meeting of the South Eastern Union of the Scientific Societies at Rochester (Messrs. S. Roberts and Breed) represented the Society there, and duly conveyed the invitation sent by this Society for the Union to meet in Brighton next year.

During the past year the Society has lost one Member (Honorary) by death, Mr. C. L. Prince, of Uckfield, and seven have resigned. Twenty-two new Members have, however, been enrolled, leaving a net increase of 14.

The Excursions have been as follows :—

June 11th.	Heathfield and Brightling.
" 25th.	Leonardslee.
July 16th.	Saddlescombe.

Papers read before the Society at its Ordinary Meetings :—

1898.	Oct. 12th,	Inaugural Address : DR. TREUTLER.
"	Nov. 11th,	"Protection in Nature" : COL. SWINHOE.

1898.	Dec. 7th,	"Light - Holding Appliances from the Earliest Times": Mr. E. Lovett.
1899.	Jan. 11th,	"Microscopical Demonstration": Mr. Caush.
"	Feb. 22nd,	"Pain": Mr. G. Morgan, L.R.C.P., &c.
"	Mar. 13th,	"The Skin of Liquids": Dr. Draper.
"	April 26th,	"The Röntgen Rays as an Aid to Scientific Investigation": Mr. E. Payne, M.A.
"	May 10th,	"Before and After Newton": Mr. H. Davey, Junr.

In addition to these, there have been the following Lectures, to which the public were admitted on payment:—

1898.	Nov. 22nd,	"Telegraphy, With and Without Wires," by Dr. Fleming; in the Pavilion.
1899.	Feb. 16th,	"Spiders: Their Work and Their Wisdom," by Dr. Dallinger; in the Dome.

LIBRARIAN'S REPORT.

Only 90 books and periodicals have been lent out during the past year. This is the lowest figure reported for some years, and it is to be regretted that Members do not more frequently use the Society's valuable Library.

The Society is indebted to H. Willett, Esq., for the gift of Robinson's "Wild Traits in Tame Animals," London, 1898. A section of this work was read by the author at one of our meetings during the past year.

A number of large and valuable works have been received from the Smithsonian Institution, in continuation of the several series begun in past years.

The Society has also to thank Mr. W. Thorpe, of Ship Street, for kindly sending a volume which he had bought among a parcel of books, and which proved, upon inspection, to contain the Society's label. It is the Series of Gosse's "Romance of Natural History," and must have been lost for at least twelve years, as it did not appear in the Catalogue printed in 1886.

H. DAVEY, Junr.,
Hon. Librarian.

BOTANICAL SECTION.

A Meeting was held on the 5th December, 1898.

Mr. Lewis gave an account of a visit to Norway, and plants added to the Herbarium during the year was examined.

At a Meeting on the 17th May, 1899, the Committee and Officers were re-elected.

Three evening Excursions were arranged for during the year, but only one was, through unsettled weather, successful. Six members attended, that to Hassocks sandpits and Clayton Downs, and some interesting specimens were collected.

T. HILTON, *Secretary.*

Since the last Report the following have been added to the Society's Herbarium of Sussex plants :—

Erodium Cicutarium, b. chœrophyllum.	Newmarket Hill.
Zanichellia brachystemon.	Sidlesham Mills.
Zanichellia pedunculata.	Rye.
Prunus cerasus.	Iford.
Scirpus pauciflorus.	Henfield Common.
Œnanthe silaifolia.	Bury.
Potamogeton friesii.	Iford.
Orobanche elatior.	Iford.
Chenopodium vulvaria.	Shoreham.
Agrimonia odorata.	Storrington.
Bunias orientalis.	Hassocks.
Rubus dumnoniensis.	Seaford.
Rubus echinatus.	Race Hill, Brighton.

MICROSCOPICAL SECTION.

Two Meetings have been held during the Session, viz., on January 25th and March 29th, at the first of which Mr. D. E. Caush gave a demonstration of "Dark Ground Dry Mounting," and at the latter took up the subject of "Mounting Starch Grains, Pollen, &c., in Carbolized Water." Both demonstrations were followed by an exhibition of slides.

DOUGLAS CAUSH,
Chairman.

W. W. MITCHELL,
Hon. Sec. Micro. Section.

May 25th, 1899.

METEOROLOGICAL SECTION.

THE METEOROLOGY OF SUSSEX.

The accompanying Meteorological Report for the twelve months, July, 1898, to June, 1899, shows that England, and particularly its south-eastern portion, is still in the midst of the cycle of dry seasons which have prevailed with slight intermission since the end of 1886. This will be clear from the following figures of annual rainfall from 1887 onwards, which were as follows:—22·10, 28·16, 27·45, 23·61, 34·38, 26·47, 24·13, 31·95, 25·19, 27·84, 29·12, and 20·41. The annual rainfall of ten of these twelve years was below the average for 1877-98 (*i.e.* 29.45 inches), the lowest of the series being 1898. The total rainfall of the above twelve years was 320·8 inches. The amount if the rainfall had been equal to the average amount in the 22 years, 1877-98, would have been 353·4 inches.

These annually recurring deficiencies of water have caused considerable difficulties as to water supplies in the South-Eastern Counties. The Brighton Corporation have taken special steps to prevent the possibility of similar dearth in connection with the large area supplied with drinking water by them. New wells with large yields of purest water have been secured, and still further wells are in contemplation.

From the public health standpoint, years of deficient rainfall, which are nearly always associated with excessive heat, are always accompanied by an excess of the diseases against which hygienists have to combat. The elements in the last twelve years have certainly fought in the opposite direction to the preventive measures which have been in operation. The writer has shewn elsewhere that such diseases as rheumatic fever and diphtheria are more prevalent when dry seasons succeed each other without long continued intervals of wet weather. The same remark is true for scarlet fever, erysipelas, diarrhœa, and many other diseases, as proved by the vital statistics of every part of England and Wales.

The present Meteorological Report is deficient in respect of the absence of the usual comparison between the climatology of Brighton and Crowborough. This deficiency is, I regret to say, caused by the decease of Mr. Leeson Prince, who for a long series of years had carried out complete meteorological observations, first at Uckfield, then at Crowborough Beacon. These observations are probably the most complete and long continued of any in this part of England, and it is a deep cause of regret to all scientists, as well as to the personal friends of Mr. Prince, that the series is now broken by Mr. Prince's death.

ARTHUR NEWSHOLME.

TABLE I.

Month.		Temperature of Air during Month.			Relative Humidity of Saturation = 100.	Wind. Number of Days of									Rainfall.		Sunshine.	
		Highest.	Lowest.	Mean.		N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.	Number of Days on which Rain fell.	Amount collected in Inches.	Number of Sunless Days.	Number of Hours recorded.
July,	1898 ...	77·4	46·0	62·0	72	6	2	1	1	—	7	5	7	2	5	0·36	2	213·83
"	1877-98 ...	85·0	45·0	61·6	73										13	2·42	1	218·62
August,	1898 ...	85·0	49·8	65·0	74	4	8	2	—	2	10	4	1	—	8	1·11	3	216·49
"	1877-98 ...	85·0	44·3	61·8	75										13	2·48	2	205·04
September,	1898 ...	81·4	39·8	62·6	71	3	7	3	3	—	4	3	3	4	6	1·02	—	218·58
"	1877-98 ...	83·2	35·9	58·2	79										12	2·62	2	168·43
October,	1898 ...	69·8	41·8	56·2	81	2	7	3	3	1	8	4	2	1	15	3·54	10	80·33
"	1877-98 ...	73·0	29·5	51·5	78										17	4·03	6	121·04
November,	1898 ...	60·2	30·0	48·3	87	3	4	2	3	2	3	2	2	9	17	3·41	10	84·60
"	1877-98 ...	63·5	17·9	46·0	86										16	3·32	10	73·40
December,	1898 ..	56·6	28·2	47·1	87	4	—	—	1	6	7	6	6	1	18	2·60	16	51·41
"	1877-98 ...	69·4	17·6	41·8	83										15	2·67	13	56·57
January,	1899 ...	53·4	31·0	44·4	87	5	4	—	1	6	7	5	—	3	18	2·67	13	74·58
"	1877-98 ...	63·6	12·0	39·3	86										16	2·68	12	57·03
February,	1899 ...	54·2	27·6	43·7	86	2	5	4	1	8	2	1	1	4	12	2·80	7	113·07
"	1877-98 ..	58·0	17·4	41·1	81										13	1·98	7	86·75
March,	1899 ...	61·2	23·2	42·5	79	8	3	1	—	3	8	3	3	2	7	0·61	2	175·66
"	1877-98 ...	65·0	20·2	42·4	81										13	1·89	4	139·23
April,	1899 ...	58·0	34·2	48·2	84	2	3	1	1	3	4	7	5	4	20	2·44	4	139·92
"	1877-98 ...	75·4	28·0	46·8	81										12	1·79	3	180·73
May,	1899 ...	68·8	37·0	52·3	79	2	9	1	—	3	7	6	—	3	7	1·09	1	233·41
"	1877-98 ...	78·1	30·0	53·1	73										12	1·73	2	237·94
June,	1899 ...	77·8	45·0	60·8	71	2	7	4	6	3	1	2	1	4	5	1·04	2	280·50
"	1877-98 ...	85·0	37·0	59·2	72										11	1·84	2	221·22
Entire Year...	...	85·0	23·2	52·7	79	43	59	22	20	37	68	48	31	37	138	22·69	70	1882·35
1877-98	... ...	85·0	12·0	50·2	79										163	29·45	64	1766·00

Brighton and Hove Natural History and Philosophical Society.

TREASURER'S ACCOUNT FOR THE YEAR ENDING 14th JUNE, 1899.

Cr.

	£	s.	d.
To Balance in the hands of the Treasurer, 8th June, 1898	7	4	0
" Annual Subscriptions and Arrears to 1st October, 1898	5	10	0
" Annual Subscriptions to 1st October, 1899 ...	60	10	0
" Annual Subscriptions to 1st October, 1900 ...	0	10	0
" Entrance Fees	9	0	0
" Dividends on £100 2¾ per cent. Consolidated Stock, for one year, to 5th April, 1899 ...	2	15	0
	£85	9	0

Balance in the hands of the Treasurer, 14th June, 1899 £4 7 10

There is a sum of £100 2¾ per cent. Consols invested in the names of the Hon. Treasurer and Hon. Secretaries, as Trustees for the Society.

Dr.

	£	s.	d.
By Books and Periodicals	6	17	7
" Bookbinding	0	18	3
" Printing Annual Report and Abstract of Proceedings	13	10	0
" Printing and Stationery (General)	6	10	9
" Printing and Postage, &c., of 2,500 Programmes of Meetings	9	11	4
" Postages, &c. (General)	8	15	9
" Scientific Secretary, Honorarium for the current year	15	5	0
" Subscriptions to Societies	2	1	0
" Clerk's Salary	2	2	0
" Commission to Collector of Subscriptions ...	2	10	6
" Gratuities to Assistants at Museum	3	0	0
" Expenses of Meetings and Excursions	8	15	9
" Brokers' Charges on Transfer of Consols	0	5	3
" Fire Insurance Premium for Books	0	18	0
" Balance in the hands of the Treasurer, 14th June, 1899	4	7	10
	£85	9	0

Audited and found correct, September 4th, 1899,

F. GEO. CLARK, F.C.A.,
Hon. Auditor.

RESOLUTIONS, &c., PASSED AT THE ANNUAL GENERAL MEETING.

After the Reports and Treasurer's Account had been read, it was proposed by Mr. Pankhurst, seconded by Mr. Caush, and resolved—

> "That the Report of the Council, the Treasurer's statement (subject to its being audited and found correct), the Librarian's Report, and the Reports of the Committees of the several Sections now brought in be received, adopted, and printed for circulation as usual."

The Secretary reported that in pursuance of Rule 25 the Council had selected the following gentlemen to be Vice-Presidents of the Society for the ensuing year—

> "Mr. J. E. Haselwood, Dr. A. Newsholme, Mr. D. E. Caush, Mr. E. J. Petitfourt, B.A., F.C.P., Mr. J. P. Slingsby Roberts, Dr. E. McKellar, Dep. Surg. Genl., J.P., and Mr. A. G. Henriques, J.P.

And that in pursuance of Rule 42 the Council had appointed the following gentleman to be Honorary Auditor—

> "Mr. F. G. Clark, F.C.A."

The Secretary also reported that the following gentlemen who had been elected Chairmen of Sections would, by virtue of their office, be Members of the Council—

> "*Botanical Section:* Mr J. Lewis; *Microscopical Section:* Mr. D. E. Caush; and that the following gentlemen who are Secretaries of Sections would also, by virtue of their office, be Members of the Council:—*Botanical Section:* Mr. T. Hilton; *Microscopical Section:* Mr. W. W. Mitchell.

It was proposed by Dr. W. J. Treutler, seconded by Mr. J. C. Clark, and resolved—

> "That the following gentlemen be officers of the Society for the ensuing year:—*President*: Dr. W. J. Treutler: *Ordinary Members of Council*: Dr. A. H. Dodd, Mr. Harrison, D.M.D., Dr. F. J. A. Waring, Mr. J. Lewis, F.S.A., C.E., Mr. Payne,

and Mr. W. Clarkson Wallis ; *Honorary Treasurer:* Mr. E. A. T. Breed ; *Honorary Librarian:* Mr. H. Davey, Jun. ; *Honorary Curator:* Mr. B. Lomax, F.L.S. ; *Honorary Secretaries:* Mr. Edward Alloway Pankhurst, 3, Clifton Road, and Mr. J. Colbatch Clark, 64, Middle Street ; *Assistant Honorary Secretary:* Mr. H. Cane."

It was proposed by Mr. E. A. Pankhurst, seconded by Mr. H. Davey, Jun., and resolved—

"That the sincere thanks of the Society be given to Dr. W. J. Treutler for his attention to the interests of the Society as its President during the past year."

It was proposed by Mr. H. Davey, Jun., seconded by Dr. Treutler, and resolved—

"That the sincere thanks of the Society be given to Mr. E. A. Pankhurst, Mr. J. Colbatch Clark, and Mr. H. Cane, the Honorary Secretaries and Assistant Honorary Secretary, for their services during the past year."

And it was resolved on the motion of Mr. D. E. Caush, seconded by Mr. Slingsby Roberts—

"That the best thanks of the Society be given to Mr. E. A. T. Breed for his services as Honorary Treasurer during the past year."

SOCIETIES ASSOCIATED,

WITH WHICH THE SOCIETY EXCHANGES PUBLICATIONS,

And whose Presidents and Secretaries are *ex-officio* Members of the Society :—

British Association, Burlington House, Piccadilly.
Barrow Naturalists' Field Club.
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Tunbridge Wells Natural History and Antiquarian Society.
Watford Natural History Society.
Yorkshire Philosophical Society.

LIST OF MEMBERS

OF THE

Brighton and Hove Natural History and Philosophical Society,

1899.

N.B.—Members are particularly requested to notify any Change of Address at once to Mr. J. C. Clark, 64, Middle Street, Brighton. When not otherwise stated in the following List the Address is in Brighton.

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BRIGHTON AND HOVE

Natural History & Philosophical Society.

ABSTRACTS OF PAPERS

READ BEFORE THE SOCIETY,

TOGETHER WITH

THE ANNUAL REPORT

FOR THE

YEAR ENDING JUNE 13th, 1900.

Brighton:

J. G. BISHOP, PRINTER, "HERALD" OFFICE.

1900.

*** By inadvertence the Lecture of Dr. DRAPER was misplaced in the order of date.

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SESSION 1899-1900.

WEDNESDAY, OCTOBER 11TH, 1899.

INAUGURAL ADDRESS

BY

PROF. G. S. BOULGER, F.L.S., F.G.S.

"Man's First Contact with Nature."

IT was not in the inhospitable barren northern lands that we should look for the cradle of the human race, but in a zone more luxuriant in variation, "the home of our collaterals, the tailless apes." There were a good many problems that arose over these beginnings of the human race.

Did primeval man, for instance, pass through a rudimentary stage of culture in which wooden implements alone were used, implements of which, from their perishable nature, no trace is likely to remain? Such a stage seems almost to be preserved to us in the existing condition of the Ainu of Northern Japan,—a persistent anthropological type, as it were,—the best description of whom we owe to that intrepid traveller, Mr. Savage Landor.

The Ainu cannot make pottery, and have no metallurgy. They use large shells as drinking vessels, and formerly used them also for shaving. They use needles of fish-bones, nets of twisted vine-stems, dug-out canoes with wooden anchors, bows each of one piece of yew, 50 inches long, with bamboo or bone-tipped arrows, and war-clubs only occasionally inlaid with stone. They care more for ornament than for clothing, tattooing themselves with cuttle-sepia or smoke-black, and wearing large metal ear-rings and glass necklaces, received in barter from the Japanese, Coreans, or Chinese, though they do not distinguish

gold from brass. The use of flint and steel they learnt from the Japanese.

But, perhaps, it is unnecessary to assume such a wooden stage, since we are assured that even the apes use stones as well as sticks, throwing them at intruders, — the most primitive welcome to strangers,—and also employing them to break cocoanuts. It is, however, interesting to remember in this connection that, apart altogether from the employment for that purpose of flints and pyrites, there is a primitive method of obtaining fire from sticks alone, a plan still in use among the Australian blacks ; that throwing stick or boomerang seem more primitive than bow and arrow, and may well be at least co-eval with the stone celt ; and that Mr. Lovett has described fish hooks made of thorns as still in use in Essex and on the French coast.

With regard to the first of these survivals it is well to bear in mind the lesson, which Mr. Kipling has emphasized for us in his Jungle Books, that the use of fire is undoubtedly one of the most distinctive and most progressive prerogatives of man. Fire existed, whether in the volcanic crater or lava-flow, or in the lightning flash that might ignite the prairie, before the real Prometheus brought it under human control. There still are some Australian tribes who are ignorant of any means of re-kindling a fire, having, if all their fires happen to become extinguished, to obtain a fresh light from another settlement. Perhaps folk-lorists might accept the suggestion even that the sacred office of the Vestal Virgins,—and perhaps even more persistent religious ceremonies,—preserve the memory of such a stage in the advance from barbarism ; and it has been suggested that the two crossed sticks, one of which is revolved in that wide-spread instrument, the fire-drill, are the origin of that svastika or cross which firgues as a sacred symbol in many diverse creeds."

Until man took to protecting himself from some more rigorous climate by the use of clothing, and invented a pocket, much private property and the incentive which the 'magic of ownership' would give to painstaking shaping of stick or stone implement would not exist. Theoretically the first 'implements' would be any stones to come to hand at the moment, to be used only at the time ; then some selection of one better fitted by Nature for the purpose in hand might be made ; and this, if man had a pocket, might be treasured, as might also one upon which some pains had been expended to shape it.

The sharp edge of a shell picked up on the beach and the broken bone of an animal that may even have died a natural death, or especially those hard limb bones split longitudinally, as even a jackal can do, for the sake of the marrow, suggest subsi diary weapons ; whilst the stringy bark of a tree or the sinew of

an animal provides the wherewithal for the primeval lanyard which carried the celt, for the fastening with which it might be bound to a wooden handle, or for the string of the necklace of shells or teeth. The use of a pebble of the brook, whether as hammer or as projectile, is, Professor Boulger remarked, so simple that I do not think it necessary to assume that any time need have elapsed before man arrived at it.

Professor Boulger quoted from Dr. Semon's descriptions of the natives of Australia. All their weapons are "of stone, shell, bone, wood, vegetable fibre, and animal sinew." Their "culture stands on a level comparable to the stone age of our European ancestors. The use and treatment of metal is entirely unknown, though of course the tribes in communication with whites freely use the steel knives and tomahawks given to them, preferring them when once they have them to their clumsy self-made stone arms." The Australian, the Professor added, is entirely ignorant of pottery, nor does he practice agriculture in any form; and Dr. Semon is of opinion that even the boomerang, the only object of native manufacture which is superior to anything of the kind made by other races, may have been discovered accidentally. But even the careful copying of such an accidentally-discovered pattern and the constant transmission of the type from generation to generation says something for their culture.

It is universally agreed that man in advancing from his primeval state is for a lengthy period in the nomad hunter stage before he takes to the pastoral or to the agricultural state. The evidence of remains seems everywhere to justify this conclusion; and, though what has, perhaps unwisely, been called the Stone Age was certainly not in simultaneous existence in many countries, the similarity of the remains referable to it from different lands is undoubtedly remarkable. From Canada to Patagonia, from our own river-drifts to the Upper Nile and the laterite clays of India, the type is, speaking generally, the same. Yet undoubtedly the date of this stone stage of culture, and especially the date of its close, was totally different in the Valley of the Nile, in India, in Britain, and in Australia.

Some interesting speculations on the life of man in this dawn of the race were advanced by the Lecturer. He observed that "Canon Tristram long ago pointed out how Arab hunters to-day occupy caverns alternately with the hyæna, coming to hunt in a district until the game is exhausted, and driving out the four-footed troglodytes, who return on their departure. Kent's Cavern, Torquay, and many another pre-historic cavern bore testimony to an identical state of things in the remote past."

Now to these primitive hunters hunting was a necessity. We speak of it as "sport," of our quarry as "game"; but to

them it was a very real struggle for existence. They had, at one time, to defend themselves against beasts of prey not to be eaten, and at another time to kill that they might eat. With such stimuli all the observant and reasoning faculties that the savage hunter possessed would certainly be brought to bear upon the chase. "First of all," says Dr. Louis Robinson, "he must have a general knowledge of natural phenomena, accurate and inconceivably extensive, so that when he is afield every item among his innumerable surroundings is so familiar that the least unusual circumstance at once arrests his attention. Next, he must have acquired, in addition to his general knowledge, a complete mastery of the complex art of tracking and stalking, so that he may approach near enough to his wary game for his rude weapons to take effect. If we go no further than this, we find that the untutored savage in his native wilds almost comes up to that formula which defines culture as "knowing something of everything and everything of something." But other gifts are required beyond mere knowledge and skill. There must be an infinite capacity for taking pains (which has been given as a definition of genius), and also, and above all, there must be a power to reason accurately from the facts observed. . . We may be tolerably positive that our early hunting ancestor had the 'invariable and essential mental habit. . . not only to gather facts, but to read their meaning, both immediate and remote." . . Many people who have spoken with contempt of the mental capacity of the Bosjesman and the Black Fellow can never have estimated the mental resources required for ordinary 'spooring!' You may perhaps remember, said the Lecturer, that when Voltaire wanted to illustrate the logical methods of such a task, he imagined, not a savage, but, an Oriental sage, Hadig, that precursor of Mr. Sherlock Holmes whom Professor Huxley took as the type of the man of science.

Two instances were mentioned by Professor Boulger of the advanced technical skill of the hunter that have made some writers imagine that before the dawn of intellect man was gifted with varied instincts now replaced by ratiocination. Professor Daniel Wilson in his 'Pre-historic Man' figures a Fuegian harpoon which is slighty curved to allow, it is suggested, for the refraction of the water; and he quotes from a French traveller a circumstantial account of turtle-hunters on the river Amazon, who, knowing that if they shoot directly at the turtles their arrows will glance off the polished carapace, discharge them into the air so as to fall vertically upon the animal, surely a very remarkable achievement by mere empirical training of the eye as a substitute for any mathematical theory of projectiles.

Man's main considerations in his attitude towards Nature in this primitive stage being his personal safety and his imme-

diate requirements in the matter of food, and in the more rigorous climates, clothing and shelter, he would naturally be eminently materialistic and probably altogether devoid alike of most of that æsthetic sense exhibited in the perception and enjoyment of beauty, and of all that sympathy for the lower creation, which we now term distinctively humanity, which make up between them so much of our own feeling in the matter. As to the former of these, however,—the sense of beauty,—we have, seemingly, direct evidence, amplified by the analogies of modern savagery, that a love of personal adornment is—in both sexes indiscriminately—so primitive that we are tempted to believe that, though not so highly developed an instinct, perhaps, as that which has led to the sexual selection of the wondrous colour-schemes of insects and birds, there was an innate love of the beautiful in man, more comparable, perhaps, as that which has produced the colours of the mandrill. Perhaps, even here, however, we can trace a utilitarian origin. The necklace of shells or claws, or at a later period of beads, metal, or other objects, obtained perhaps by barter from some higher race, is so general among savages, and even in early entombments, that we think it must have had an innately æsthetic origin. Though the fossil echinoid, evidently carefully chosen as the handle of a flint implement, would be a means of proving ownership, or might become the primeval insignia of rank, its first choice, and the rows of 'shepherds' crowns' and 'snakes' hearts' round the skeleton in a barrow, seem alike to have arisen from that mere sense of the bizarre which is to-day an important element in our conventional notions of beauty. Is it not, however, possible that, as a white under-surface to the tail proves useful to the rabbit as a recognition mark, some feathers stuck in the hair of a chief as his oriflamme, or those painful slashings of the cheeks, or smearing or tattooing the body with pigments, may have been the strictly utilitarian origin of much personal adornment, which in later stages has become an object in itself?

As far as the Lecturer could tell, there was no evidence of domesticated animals during the Palæolithic age, but in later hunting periods arose a practice of keeping of pets, to which we might attribute the first softening of attitude towards Nature and the beginning of humane feelings. This led Professor Boulger to touch upon some difficult problems, whether any particular progress of the human race had originated in the mind of one great genius, a Cadmus, Triptolemus, Tubal Cain, or Sequoia, and had then been transmitted from tribe to tribe, whether by international trade or by conquest, or whether it had been reached independently in many times and places. These questions concerned alike the utilisation of fire, the art of polishing flint, the potter's wheel, the lathe, the smelting of

metals, and the alloying of copper with tin,—steps of the very highest import in the early history of civilisation.

A consideration of the high state of civilisation reached by a race that seemed to have preceded the Egyptians led Professor Boulger into a disquisition of the possibility of there being a copper age preceding what is universally recognised as the bronze age. Gold was a metal known to the earliest of men, and it seemed probable that they considered copper equally valuable, if not the same thing. The Lecturer quoted Mr. Gladstone as looking upon a word in Homer usually interpreted as bronze as meaning copper, and he referred to other data as proving that at one time copper was the chief metal in use. Then there came the discovery of tin, and by some accidental circumstance, probably a big forest fire, man discovered that the metal could be obtained from the ore by fire, and that it could be alloyed with copper to make that much harder compound known as brass. Incidentally the Lecturer said that though the Phœnicians may have obtained casual supplies of tin from Britain, they probably obtained most of it from Mashonaland. However it came about, this discovery of the art of alloying tin with copper marked an important epoch in the history of mankind, since with the coming of bronze man passed from barbarism to civilisation.

WEDNESDAY, NOVEMBER 15TH, 1899.

Gilbert White, of Selborne.

MR. EDWARD A. MARTIN, F.G.S.

TO illustrate his lecture, Mr. Martin made use of a large number of well-executed lantern slides, mostly from photographs, and the lecture resolved itself as much into a description of the pictures, as the pictures were illustrative of the lecture. Mr. Martin impressed upon his hearers the great value to naturalists of Gilbert White's one book, and he deprecated the fact that it was so far from being appreciated now-a-days as it deserved. Gilbert White might really be termed the father of natural history, and, though the discoveries of later day scientists have made some of his book out-of-date, there still is a great portion of it that has not yet been superseded. Even

more valuable than the information imparted by the book, Mr. Martin thought, is its influence, as opening men's eyes to the study of all the forms of Nature that they find about them, and the example it holds out of what may be achieved by close, intelligent observation of what lies immediately about one in the inexhaustible realms of Nature. He wrote only one book, "The Natural History of Selborne," but that book had given him a sure niche in the temple of English literature. It is for us to follow his example, and, retiring into the woods and forests, drink in the healthy influence which the perusal of such a book brings to us.

As to Gilbert White's history, Mr. Martin told how he lived from 1720 to 1795, and was Curate at Selborne and the neighbouring village of Farrington. It was a time of considerable political unrest in England and on the Continent, the latter part of his life extending over the French Revolution, but Gilbert White went on undisturbed, placidly noting how the birds lived and the flowers grew, "more concerned with the course of events in building a marten's nest than in the crash of Empires." His famous book was originally not written for publication, but was made up of letters he had despatched to two friends of his during a considerable number of years. Eventually his brother persuaded him to have these letters collected and put into book-form, and so it was that "The Natural History of Selborne" was saved to the world. Most of these letters were written from Farrington and Selborne, but three are dated from Ringmer, in Sussex, with whose Down scenery Gilbert White was greatly impressed. Having only this limited area to draw upon, Gilbert White's opportunities in one way were limited, but it happened, fortunately for him and for us, that, if an observer's field of research had to be limited to one village, then Selborne was an ideal place for such an observer. Its peculiar geological position, at the extreme edge of the Wealden clay, where it was broken into by other formations, made it almost unrivalled as a place for "specimens" of all the kinds sought by the naturalist. Whatever came to hand Gilbert White studied most sedulously. His forte was ornithology, but he took note of and wrote upon everything that he could find, from fossils to rush-lights. The life of a country clergyman in those days was not very burdensome, and he had plenty of time to devote to his hobby. An amusing instance of the easy way the Clergy worked in the Georgian period was incidentally provided by the exhibition of a leaf of a sermon written by Gilbert White, which his diary showed he had used some twenty times. As to his thoroughness in getting the most he could out of the material at hand, the Lecturer mentioned that the number of fish he was able to examine was very few indeed, but he made up for it by the exhaus-

tive nature of his studies upon some gold fish belonging to a friend. His experiments with his famous tortoise, Timothy, also came in for remark.

Regarding Gilbert White's influence, Mr. Martin pointed out how much Darwin admitted owing to the naturalist of Selborne. Many men of science had taken to editing his works, down to Grant Allen, whose edition the Lecturer considered to be the best.

A good deal of the lecture was taken up with following out points suggested by Gilbert White in his book. For instance, his remarks on the sparrow led Mr. Martin into a short disquisition as to the utility of that much-abused bird. In towns, Mr. Martin thought, the sparrow's capacity as a scavenger made it invaluable; in the country, he left it as an open point whether it did more harm than good. Then the author's speculations on the relation between the animals of England and America brought Mr. Martin out with maps and diagrams to show that it was probable that in some prehistoric period England, Europe, and America were all connected by a belt of land that included Iceland.

Another section that figured prominently in the lecture, though Mr. Martin dealt with all incidentally, making no attempt to group them, was a description, from the Lecturer's point of view, of the topography and geology of the village of Selborne. Into this subject he went minutely, pointing out the objects of interest to be found in the village, and practically telling his audience all that there was to be said about them. In this task, evidently one greatly congenial to his tastes, Mr. Martin was materially aided by his numerous excellent photographs. He warned intending hero-worshippers that a tablet in Selborne Church saying that Gilbert White's tombstone "is the fifth from this wall," was altogether misleading. By some maladroitness, the tablet has been put in the wrong wall.

WEDNESDAY, DECEMBER 6TH, 1899.

Climbing the Andes.

SIR MARTIN CONWAY, F.R.G.S., &c.

IT was some eighteen months ago that Sir Martin, who has climbed mountains in many parts of the world, and is a Vice-President of the Alpine Club, set out to seek fresh adventures on the hitherto untrodden peaks of the Cordillera Real, in the Republic of Bolivia,—the Thibet of South America. The Lecturer commenced the description of his journey at the point where, on the upward way towards the mountains, he and his two Swiss guides set foot on the little steamer that was to carry them across the Lake of Titicaca. This extraordinary lake, many times larger than Geneva, and already some thousands of feet above sea level (though within appreciable distance of the Equator), they crossed with comfort. In so doing they were fortunate, for, as a rule, its waters are agitated by the most unpleasant storms, so that the voyager suffers not only from the rarefaction of the air, or mountain sickness, but from seasickness as well. The combination of the two maladies, Sir Martin assured his audience, was "one of the most insidious forms of illness it is possible to conceive." Moreover, it is the rarest thing to find a person capable of becoming habituated to it. On the Titicaca steamboats passengers and crews are alike prostrated.

From the waters of the lake, across dark intervening mountains of lower level, the traveller and his comrades commanded a view of the white towering solitudes they had come to explore, masses of gleaming ice piercing the blue equatorial sky. Mount Sorata towers at the north end of the Cordillera, more than 20,000 feet above the sea, while in the giant Illimani, invisible as they approached from the lake, the range culminates at the southern end. Beautiful photographs, of glacier, gorge, and rearing peak, were thrown upon the screen as the lecture progressed.

Lake Titicaca and the district round about was the original home of the great Inca civilisation. Indians of pure Inca blood still inhabit the region, having the civilisation no longer, but

speaking the same language as in the old days of power, telling the same wild legends, retaining the same religion,—just varnished over with a little Christianity.

Finding the northern face of the mountains impossible, Sir Martin Conway took up his headquarters at the town of La Paz, from which he set out to climb Sorata and Illimani. Mules could be employed to a height of about 14,000 feet, after which the baggage had to be carried on the backs of men, while in the actual snowy region itself they had to do with very little baggage.

Incidentally the Lecturer mentioned that all this mountain region was rich in mineral deposits, though these were as yet little worked, in consequence of the lack of fuel and the difficulty of getting at them. Of one place, where an American Company had taken possession of a "basin" in the rocky valley, he showed photographs. Down the basin ran a mountain stream, and the sides of the basin were rocky walls, towering hundreds of feet. All the Company's machinery had to come down a narrow path, over whose precipitous edge the sure-footed mules would sometimes slip and fall, bouncing from boulder to boulder, till they crashed, broken and bleeding, on the basin bed far below. High up above in the mountain they had cut a canal between two mountain streams, and from the canal to the basin below had run an iron pipe, four feet in diameter at the top, diminishing gradually to an orifice at the bottom eight inches in diameter. Through this orifice, which could be turned in different directions, the tremendous downward pressure of gravity exerted, through the water, a force equivalent to some 8,000 horse-power, and by this means the bed of the stream was washed through sluices. When all the basin had thus been worked, the place would be abandoned, and the wall would remain, for perhaps thousands of years, "a monument to the interest the people of the 19th century have taken in finding gold."

On the long laborious journey up, the adventurers came to a spot when it seemed as though hopes of winning the principal peak must be abandoned, for the great snow-field that led up to the highest point of the mountain ended in long walls of ice that hung over like the end of a spread table-cloth. To approach beneath this ice was to court annihilation, for ever and anon vast masses would fall crashing from the heights, shivering upon the rocks and precipices, and bounding off down the mountain's flanks in great avalanches of ice that broke into ever smaller pieces till it became a fine dust. At last they heard of a valley by which they could mount higher, and for several days pursued their way up a drift of loose rocks, similar, in the photograph, to those that strew the upper portions of the Welsh hills. They had now reached uninhabited regions, and the

Indians who carried the baggage were getting nervous. As in all mountain regions, the people firmly believed that the uninhabited zone of the mountains was the abode of devils. Every one of the great stones that lay along their present track had, the Indians maintained, been kicked down by a devil. Whenever they heard a rock spring loose and come tumbling from above, they looked up anxiously to see the devil. The theory of these devils was much against rapid progress. Wherever the Indians could they sat down. Sir Martin estimated humorously that they sat down 50 minutes in every hour at this part of the ascent. At last, however, the poor Indians could stand their diabolical surroundings no longer, and at one camp they all ran away, except two, more daring than the rest, who remained for the novel experience of sleeping in a tent. But these also began to be overcome by fears, and hung back when the party came to an extra bad place. "Fortunately I had brought with me a lot of silver coins, and I would go fifteen or twenty yards ahead and hold out a coin, and they would come and get it, and then I would go on a little further and hold out another, and so on, and as we got higher and higher the silver coins had to get bigger and bigger. But finally we came to a very bad place, but they no longer took any interest in dollars, and nothing could get them any higher. And some hours later faint howls of delight came up to us through the still air, telling that they had got safely off the cursed rocks again."

So Sir Martin Conway and the guides had to do their own carrying now. In these high altitudes the air was so rarefied, and the amount of oxygen breathed at each inspiration so small, that merely to get about was exhausting. Half-an-hour's work in such a light atmospheric pressure fagged one as much as five hours' work at a lower level. Sir Martin had brought away some wonderful mountain views,—seas of cloud, filling the valleys beneath like snow, and cutting off the great peaks "in icy isolation."

Perseverance had its reward in the discovery of a place where the ice cap, that hung from the snow-field crowning the mountain, sloped down in a steep glacier instead of hanging overhead. Here they made their way up, and, about a quarter of a mile in upon the snow-field, they pitched their highest camp. At two o'clock in the morning they set forth to mount the snow-field to the peak itself. But their difficulties were not yet all over, for they discovered another peak between them and the one at which they were aiming. This they had to cross, and the intervening snow-field, till at last, after one of the most toilsome half-hours in their experience, they mounted the topmost summit of Illimani, and before their eyes, though clouds

were gathering, a vast panorama lay stretched for two hundred miles. Standing there, more than 21,000 feet above the sea, they spent an hour planting their little Union Jack,—soon to vanish in the tempests of the mountain top,—and assimilating the sensation of standing where no human foot had stood before.

As for the return journey, Sir Martin was very brief. With humour of the American kind he described the return journey of what baggage they had taken to the summit, and no longer required. "We wrapped it all up in a bundle, and rolled the bundle to the edge of an ice gulley. Then we let go, and it slithered down, and soon began to make little jumps along the ice. Then it jumped fifty yards, and then half a mile, and then twenty miles, and then it scattered like a lyddite shell all over the country of Bolivia. When I passed my sleeping bag again on my way down there were eighteen different ways of getting into it."

Sir Martin shortly described his ascent of Mount Sorata, a similar adventurous journey. For the ascent of Sorata in the higher altitudes they carried up a small sledge, for greater convenience of conveying the baggage. They found, however, he and his two guides, that it was all their work to get along. Sir Martin made the discovery that by a wise dispensation of Providence no man could pull a sledge and take a photo of himself doing it at the same time. "Therefore, as we got higher, you will see that it became more and more necessary to take photographs." Every now and then they would come to a flat spot, and sit down, and say what a nice thing it was to have a sledge to sit on. When nearing the top of Sorata they had to stop for a snow-storm. They waited a day, but it kept on, and they had to leave their camp and bolt for their base camp as hard as they could. And it was just as well, for that snowstorm lasted three weeks. Then they returned and found their tent, and started for the peak again in the black night. The final slope of Sorata they found most treacherous with the newly-fallen snow. At each step they would sink to the chin, and had to stamp the snow down to get a footing, and all the time they were in imminent peril of creating an avalanche of the loose snow. The last hundred feet or so, which in ordinary circumstances would have only taken about a quarter of an hour, they found quite impossible, and there was nothing to do but turn back. As the peak was covered with clouds they had lost nothing but the sentimental satisfaction of actually standing upon the peak itself.

WEDNESDAY, DECEMBER 13TH, 1899.

DISCUSSION

ON

The Association of Members for the Study of some Unexplained Phenomena,

OPENED BY

MR. HENRY DAVEY, JUN.

WEDNESDAY, JANUARY 10TH, 1900.

Old Sussex Iron-Work.

MR. J. LEWIS, F.S.A.

THE lecture dealt with the flourishing iron trade of which Kent and Sussex were at one time the centre. It called up visions of a Weald, not dreaming away the years in a rural beauty changing its aspect only with the changing seasons, but belching forth fire and smoke from a score of great furnaces and foundries, and so devastating the country side that special legislation had to be enacted to protect the trees from being all used up to feed the flames. The lecture was illustrated by a number of lantern slides.

It seemed, said Mr. Lewis, hardly possible that rural Sussex was at one time the seat of a great iron industry, and, considering the extent to which that industry was carried on, it was singular that, till 1844, no one had thought it necessary to investigate its rise and fall. Speaking generally, the use of wrought iron marked the stage in the evolution of races which followed what we call the "bronze age," but the casting of iron,—the melting of it in the furnace and the forming of it in moulds,—marked a far greater advance in knowledge. The origin of the iron working in Sussex, however, seemed quite lost.

To give his audience some idea of the terrific heat necessary to melt iron, Mr. Lewis had prepared a little table. The mere figures, he said, would of themselves be unable to give any adequate notion, but let his hearers take, as their starting point, the heat of boiling water. Boiling water, though the heat of it was sufficient to cause people to make "cursory remarks" if they got a splash of it by accident, was a mere nothing by comparison with the temperature of melting iron. Water boils under ordinary circumstances at 212 deg. Fahrenheit. At 594 deg., more than double that temperature, lead fuses. At 1,342 deg., more than double this again, iron is at "welding heat," and may be hammered into shape. But even this great heat must be again more than doubled before we get to 2,786 deg., the fusing heat of iron. By what mechanical contrivance the earliest iron-casters of Sussex had obtained this enormous temperature no one as yet knew. It had been suggested, in regard to other ancient peoples who had known how to cast iron, that the winds of heaven had been pressed into service to supply the blast for the furnaces, but in view of the comparative moderation and the uncertain direction of the winds in Sussex, Mr. Lewis was inclined to doubt very much whether this could have been done here. In fact, he did not seem very much to favour the idea at all, for in India, where from ancient times iron had been worked, and where there was a hot, steady wind for many months together, the natives had told him that it was impossible to melt iron, and when he had described the process to them, they had merely looked upon him as an unusually talented liar.

It was archæology alone which threw any light on their subject. There was in the Museum at Hastings a little iron statuette about six inches high, of the date of the Roman occupation, which the best authorities agreed was cast iron. Mr. Lewis showed a photograph of it,—a rusted, time-worn, featureless little figure, with one leg missing. However, as he remarked, "in these things you have to take what you can get." Other Roman remains there were, such as coins and other articles, which had been discovered in the remains of furnaces, where there was no evidence of the presence of anything mediæval; which pretty conclusively proved that the Romans had found a way of melting iron and casting it in moulds. At the remains of an ancient furnace at Beaufort Park a coin of Hadrian had been found, while at Maresfield, coins, of dates ranging from the reign of Nero to Diocletian, had been unearthed. A photograph was shown of another ancient working at Hastings, the place round where the fires had roared long years ago being now well-wooded and grown with weeds and flowers. With the departure of the Romans for good, and the advent of the Saxon, the iron industry in Sussex may have

fallen to a very low ebb, for Domesday Book, that exhaustive and invaluable record compiled after the Norman Conquest, contains no mention of it. However, there is a record in Lewes going back to the year 1266, stating the amount then to be paid on every load of iron brought into the town. To those who read the evidence, Mr. Lewis said, it was perfectly plain that this referred either to wrought iron or to pig-iron brought in on purpose to be worked.

The re-discovery of the art of casting iron was practically a modern invention. The trade seems to have been revived in the Fourteenth Century by the finding out of a method of melting the metal and running it into moulds. The discovery, which Mr. Lewis thought was probably due to an accident similar to that which led to the discovery of glass, was not, he said, proved to have been made in Sussex. However, as the English under Edward III. were the first people mentioned as users of cannon in war, it was reasonable to suppose that they were the first to cast iron shot.

An interesting part of the lecture was that dealing with the manufacture of the early cannon in Sussex. The first cannon cast in one piece was made, Mr. Lewis said, by a Sussex man with the characteristic Sussex name of Hogg, at the village of Buckstead. About the middle of the Sixteenth Century many names of Frenchmen and Germans are found in our County Parish Registers. These men, the Lecturer thought, probably came to Sussex to study the art of iron castıng. There was a famous furnace at Lamberhurst. Comparatively few people were aware that the fine railings round St. Paul's Churchyard were cast at this same Sussex furnace at Lamberhurst. They are the greatest existing remains of the Sussex iron industry. Their weight, including the seven gates, is about 200 tons, and it is said that they compose, perhaps, the most magnificent balustrade in the world. They cost £11,202. But the Lamberhurst foundry was not always such a patriotic institution. Some of the cannon cast in it were smuggled from the seashore for use in French privateers, until such infamous traffic came to the knowledge of the authorities. One of the old Sussex cannon was shown in the illustrations,—a rude iron cylinder bound round and round for half its length, and supported on a couple of wooden beams, a curious embryo of the finished modern engines of destruction.

In the Sixteenth Century the Sussex ironworkers began to turn their attention to ornamental work for interiors. To this period belong the fire-backs and fire-dogs to be seen in many of the old country houses. The Lecturer had received from Mr. Henry Willett the loan of the only known Sussex fire-back pattern now existing. He showed it to his audience, who were

much interested in the relic. From the iron trade of the Sixteenth Century, he went on to say, many of the Sussex County families whose names are so well known to-day took their rise. Even the great Elizabethan nobles did not disdain to have large interests in the industry. So extensive did it become in Elizabeth's reign that at one time it threatened the existence of the timber in the Weald, and laws had to be specially passed to save the trees of Sussex. In the Seventeenth Century the growing scarcity of wood, the opening of the iron industry in Wales, and other causes, gradually combined to kill the Sussex iron workings, till in 1809 the last Wealden furnace ceased to burn. Last century the iron trade kept 42 forges and 27 furnaces in full activity, but, as Mr. Lewis remarked, few who know their Sussex of to-day will regret the transference of the "black industry" to another region.

WEDNESDAY, APRIL 11TH, 1900.

The Unconscious Work of the Mind.

DR. R. J. RYLE.

DEFINITIONS of the science of psychology, said Dr. Ryle, generally tell us that the science has to do with "consciousness as such," irrespective of what may be called the contents of consciousness. Such an account, however, fails to do justice to the fact that a large amount of work goes on which cannot be fairly called anything else but mental work, and it goes on unconsciously. Professor Lloyd Morgan introduces his discussion of this branch of the subject by drawing an analogy between the objects before our minds and the objects before our microscopes. In each case there is only a certain limited area of the field which is in focus (unless the object examined is destitute of thickness). Many details besides those upon which we concentrate our attention may catch our eye, but only indistinctly ; and it seems that this field, of which we are only dimly conscious, forms a borderland between what is distinctly held in consciousness and what is quite (to use a modern pyschologist's phrase) below the threshold of consciousness. Another Professor of the

same science describes the phenomenon under the similitude of a "fringe." He points out that around any distinct piece of mental work, such as the recollection of a person or place or a portion of poetry, there is an indistinct margin or "fringe," representing a region in which our minds are working, but working without our cognisance. The process which goes on when we endeavour to recollect a lost line of a quotation, and by which it cames into our heads, affords an illustration familiar to most of us.

The natural history of memory gives us, perhaps, the readiest examples of unconscious mental activity, but we may find them in all departments of our mental life. For instance, if we analyse with care the process of perception, we find that we are doing a great deal more than we are aware of. Take as an example the case of a house perceived. There are colour sensations, sensations of light and shade, sensations of form, sensations also corresponding with the objects around and beyond the house. All these are put together, to use an apt expression, as if by a secret chemistry of the mind, so as to form a definite object of consciousness, having its appropriate place and character in space and time.

Another common instance of unconscious mental activity is afforded by the work of the extempore speaker, who, with an unconscious, or at best only partly conscious, attention to an underlying thread of connection, chooses his words and sentences to accord with his varying topics and the attitude of his audience. Poets also testify to the presence of unconscious mental activity, and the late Cardinal Newman has given an eloquent testimony to the reality and importance of this aspect of mind in an Oxford sermon preached more than fifty years ago.

Analysis of the details of unconscious mental work is naturally of extreme difficulty, but, by following up all the clues we can find, it seems probable that a large part of the unconscious mental work which we do consists in the forming the dissolution and the re-arranging of associations between the ever-changing elements of our mental life,—the sensations, ideas, conceptions, volitions, and so on. Evidence in favour of this seems to be found in the process of mental development in childhood, and in an examination of the acquirement of many of our common accomplishments. The facility with which we leap from rock to rock, judging our distance, and co-ordinating the muscular effort accordingly, involves the operation of an activity, which has, no doubt, its physiological accompanying conditions of stimulus, of reflex, of inhibition, of co-ordination, &c., in the cerebro-spinal system, but it is an activity which (involving as it does such items as "less" and "more") can hardly be described appropriately except in the language of psychology.

Another point to notice is that we have not only to allow of the presence of unconscious mental activity, but we have also to allow that it is difficult to say quite where it begins and ends. The experience of sleep and dreams and the consideration of our common acts of will and imagination as well as those of attention all combine to show that the conscious activity of mind rounds off gradually and imperceptibly into the unconscious. The implications and consequences of the admission of unconscious mental activity count for something in many different directions. Autobiographies, books on logic, works of fiction, confessions of mystics, all contribute material to the study of the subject.

WEDNESDAY, FEBRUARY 14TH, 1900.

The Rhythm of Nature.

DR. C. H. DRAPER.

SOME examples of rhythmic motion are familiar to everybody. The motion of the waves of the sea, the ebb and flow of the tide, the beating of one's pulse are instances. The tides are a most interesting instance of one of Nature's cycles. The moon by her attraction heaps up beneath her 22,000 cubic miles of water and this huge lump follows her perpetually round the world. Yet not altogether perpetually. Every activity contains within itself the source of its own change, and slowly but surely the motion of the tides is stopping the motion of the world. They act as a brake on this revolving earth, and in consequence, one day, there will be no more days and nights and no more tides.

But there are rhythmical processes which more intimately concern us. Those for instance by which we hear and walk and talk. In fact, on rhythmical motion most things human depend. Before us is a pendulum swinging. The pendulum of an ordinary eight-day clock moves from side to side in one second. Could we move our hands backwards and forwards thirty times in a second, that motion would produce a low musical note. Look at the beating of the heart. "The heart contains within itself a something," says Huxley, "which causes its different parts to contract in a definite succession and at regular intervals." This successive contraction of the chambers of the heart takes place for each of us 37 MILLION times per annum.

Music is essentially rhythmical. Sound without rhythm is noise. The ear is gratified when the sounds succeed each other at definitely recurring intervals. The pendulum swinging before us has its own special rate of vibration. So long as it is as it is, and where it is, it will vibrate at the same rate and no other. This principle is of general application and musical instruments are based on it. The columns of air in the pipes of an organ have their own determined and definite periods of vibration. Dr. Draper showed many experiments illustrating this.

The drawing of a violin bow over a string presses the string slightly out of its position, the string springs back again, and these motions produce a noise pleasant or otherwise, according to the regularity of their recurrence. The musical note produced by rubbing a finger over the edge of a glass bowl, the air in the bowl responding to the vibrations in accordance with its own, the singing of a rifle bullet as it passes through the air, the singing of a tea kettle produced by the bubbles of steam rising through the water and bursting, are all instances of the same rhythmical motion. The note produced by a metallic plate which has been struck is beautifully shown by the figures into which sand strewn on its surface is thrown. The higher the note the more complex the figure, because of the more frequent the vibrations.

How is it we hear each other talk? The tongue so often spoken of as an unruly member, is not, strictly speaking, the organ of speech. People have been known to talk after their tongues have been removed. The apparatus by which the sound of the voice is really produced is the larynx. Through the aperture termed the glottis the air is continually passing. The size of this aperture is determined by the vocal cords. It is this which determines the character of the sound we utter. The vibration of the air thus produced reaches the delicate membrane within the ears of those listening to a voice, these are passed on to the nerves of the brain, and the voice is heard. These vibrations are at the rate of from one to three hundred per second, both in the person transmitting, and, of course, in the ear of the one receiving the sound.

Music can be appreciated by people who are deaf. Beethoven was deaf for a great part of his life. He used to sit with a stick pressed against the piano, the other end against his teeth, and he could hear the sounds produced by his instrument. Think of the multitudinous wave systems crossing each other in a room during a concert. From the vocal organs of the men proceed waves of from six to 12 feet in length. The higher voices of the women produce waves from 18 to 36 inches long. Each instrument in the orchestra emits its own peculiar waves. They are all again reflected from the walls of the room, and

rush backwards and forwards until destroyed by newly generated sound-waves.

But sound itself is but a sensation perceived by living beings endowed with special apparatus for the reception of those vibrations which cause it. OUTSIDE THESE LIVING BEINGS THERE IS NO SUCH THING AS SOUND. THE WORLD ITSELF IS PERFECTLY SILENT; ALWAYS AND EVER. The final secret of Nature appears to be motion. From this she constructs our world.

We pass from sound to light, and we are still in the domain of vibrations.

The rhythmical motion of the waves of the ether give to us light and colour. The intense physical and chemical changes going on in the sun affect the ether, in which the sun is immersed, and travel through it in multitudinous vibrations and with terrible speed until they reach our eye. BUT OUTSIDE THE SENTIENT EYE THERE IS NO LIGHT—only motion. THE NON-SENTIENT UNIVERSE IS NOT ONLY SILENT, IT IS UNUTTERABLY DARK. But motion is everywhere. When the ether vibrates at the rate of 400 million millions per second, the eye perceives red light. At about double that frequency we see violet light. Above or below these we see nothing at all.

Heat, light, electricity, all result from the rhythmical vibration of the ether.

FRIDAY, MAY 11TH, 1900.

Fluorescence and Allied Phenomena.

E. PAYNE, M.A.

SCIENTIFIC men have come to the conclusion that light and electricity are identical in their nature, that all light is an electrical phenomenon. This was the statement with which Mr. Payne opened his lecture, and, in order to show why they had come to this conclusion, Mr. Payne, who was provided with an excellent set of electrical apparatus, performed, for the benefit of his audience, a number of the experiments which had led the scientists to such a position.

If we accepted light as being electricity in a state of vibration, there was, he said, no difficulty in understanding the fact, which the spectrum revealed, that there were degrees of light

which our eyes could not appreciate, just as we knew that there were vibrations of sound that our ears could not appreciate. A ray of light, split up in the spectrum, revealed the existence, at either end of the visible part of the spectrum light, rays which in the ordinary way could not be appreciated by the eye,—rays at the red end, which produced heat, and rays at the violet end, which were light rays known as the "ultra-violet" rays. It was found, however, that certain substances possessed the power of making these rays perceptible. Conspicuous among these was fluor spar, upon the surface of which curious rays could be seen playing. "Fluorescence" was the name at first given to this peculiar property of fluor spar. A similar property in the opal was known as "opalesence," but scientists, recognising the effects to be of the same nature, now preferred to call the quality "luminescence" wherever it occurred. These strange surface rays were the invisible "ultra-violet" rays converted into visible rays by the peculiar property of the surface of the substances. On his table Mr. Payne had a number of solutions of different "luminescent" substances, which in the ordinary light appeared of one colour, while, when a strong light was thrown upon them, they gave off their strange rays, and appeared of quite a different tint. Some "luminescent" substances, even after the light had been removed, retained, Mr. Payne explained, their "luminescent" colour. For the purpose of illustrating this he had placed a number of pieces of such substances in partly exhausted tubes. Informing his audience that a strong current of electricity passed through "luminescent" substances at once brought out their peculiar qualities in a more conspicuous manner than ordinary light, he went on to perform a number of beautiful experiments with the substances in the tubes. Among these were rubies, which, when the magic current was turned on, glowed like living scarlet; bits of marble, which shone under its influence with a bright golden light; and a bit of calcined shell. Then there was what he called a "fancy tube," in which he had placed a variety of substances with "luminescent" effects of different colours. The result of the passing of the current through this was a beautiful effect in purple and red that was not unlike a vividly luminous thistle flower. When the current had been switched off, the brilliant glow gradually died out, like the glow of a cooling ember. Mr. Payne was careful to point out that even when the glow was brightest the substances were quite cold.

It was, he went on to say, in the course of investigations of the phenomena of fluorescence that the strange effects produced by the "X" rays were stumbled upon. Professor Röntgen had succeeded in discovering how, by means of the current in the vacuum tube, to transfer the "cathode" rays set up within the tube to outside it, so as to render "fluorescent" a screen of

platino-cyanide of barium at a short distance. In experimenting with this screen, he noticed that certain solid substances, even if interposed directly between the tube and the screen, did not prevent the "fluorescence" of the latter. Rays must, therefore, have penetrated the intervening substance, and to these unknown rays he gave the ordinary scientific denomination of an unknown quantity, and called them "X" rays. The action of these rays was brought home to the audience in a striking way by Mr. Payne, who, having entirely covered his luminous vacuum tube with some red silk, so that practically no light was emitted, held up the platino cyanide of barium screen, which immediately glowed with its pale green "fluorescent" light. "Luminous" paint, the fairy lanterns of the glow-worm and the firefly, the myriad sparkling of the tropic seas, and the baleful green of a cat's eyes in the dark, were all, he said, more or less "luminescent" phenomena.

WEDNESDAY, MARCH 4TH, 1900.

Evening for Microscopes.

REPORT OF THE COUNCIL

For the Year ending WEDNESDAY, JUNE 13th, 1900.

It will be remembered that last year an invitation was conveyed from this Society to the Congress of the S.E. Union of Scientific Societies, then meeting at Rochester, to assemble in Brighton this year. This invitation, conveyed by our delegates, Messrs. Slingsby Roberts and E. A. T. Breed, was duly accepted. and the Congress accordingly met here on the 7th, 8th, and 9th inst.

Between 20 and 30 delegates attended from Societies affiliated to the Union, and about 80 tickets were taken by members of this and other Natural History Societies and strangers.

At the General Meeting of Delegates held on the 9th inst., a hearty vote of thanks was passed to this Society for the efforts made by it for the entertainment of the Congress, efforts which, the delegates were pleased to say, had been so far crowned with

success as to make the Brighton meeting one of the most successful ever held.

The members were received by Sir John Blaker, acting for His Worship the Mayor (Mr. Alderman Stafford, J.P.), who was absent from Brighton on the evening of June 7th, and by the Mayor and Mayoress of Hove (Mr. Alderman Colman, J.P., and Mrs. Colman) on the following evening at the Hove Town Hall. Mr. Colman also kindly provided a Lecturer in the person of Mr. K. Enoch, who delighted his audience with "The Wonders and Romance of Insect Life." The Members of the Union and Associates were entertained by the Executive Committee at tea at the Pavilion on Friday evening, and also at the Booth Bird Museum on Saturday afternoon.

The Society is greatly indebted to Mr. J. Williamson, of Hove, for his exertions in connection with the Exhibition of Photographs, &c. It was due to him that such an admirable collection was exhibited in the King's Apartments.

The Council has much pleasure in chronicling the generous gift by Mr. Haselwood to the Society of a handsome bookcase, together with 328 volumes of valuable books. At a recent meeting of the Society a special vote of thanks was given to Mr. Haselwood for his munificent gift, and means were ordered to be taken for securing a permanent record of Mr. Haselwood's generosity.

It has been found advisable to propose an alteration in the Rule which decrees that the President and Council who are elected in June shall retain until October. As the arrangements for the Session are in a great part made previous to the assembling of the Society in the second week of October it has been thought right that the President and Council who are in office during the year should have the responsibility of deciding on the Programme for the Session. The alteration proposed in the new Rule will have this effect.

Mr. Lomax, having ceased to be Curator of the Museum, Mr. Toms and Mr. Hilton have been made Joint Curators of the Society's collections. The best thanks of the Society are due to Mr. Lomax for the work he has done for the Society during the many years he has acted as Curator.

During the year which has passed, the Society has lost four members by death, and four by resignation.

Sixteen new members have joined.

The papers read before the Society have been as follows:—

1899. Oct. 11th. "Man's First Contact with Nature": PROF. BOULGER, F.G.S., &c.

,, Nov. 15th. "Gilbert White, of Selborne": MR. E. A. MARTIN.

1899.	Dec. 6th.	"Climbing the Andes": Sir Martin Conway.
,,	Dec. 13th.	Discussion, opened by Mr. Hy. Davey.
1900.	Jan. 10th.	"Old Sussex Iron Work": Mr. J. Lewis, F.S.A.
,,	Feb. 14th.	"The Rhythm of Nature": Dr. Draper.
,,	March 4th.	An Evening for Microscopes.
,,	April 11th.	"The Unconscious Work of the Mind": Dr. R. J. Ryle.
,,	May 11th.	"Fluorescence and Allied Phenomena": Mr. E. Payne, M.A.
,,	June 13th.	Annual General Meeting.

Excursions:—

1899.	July 15th.	Buxted.
,,	July 24th.	Old Place, Lindfield, by kind invitation of C. E. Kempe, Esq.
1900.	May 12th.	Hassocks.

LIBRARIAN'S REPORT.

During the past year 111 books and periodicals have been lent out to Members of the Society, an increase on the previous year; but it is still to be regretted that only a small proportion of the Members use the opportunities for study which the Society's Library affords them.

The munificent gift of a bookcase and books from Mr. J. E. Haselwood, alluded to in the Annual Report, is at present, by kind permission of the Brighton Town Council, housed in the main building of the Royal Pavilion. It will be transferred hither when the New Library is built, which may be expected in 1902. Upon the transference, a new Catalogue will be issued detailing these acquisitions.

The following works have also been kindly presented to the Society:—

Martin, E. A., Bibliography of Gilbert White (Presented by the Author).

Gaudry, Albert, Les Ancêtres de Nos Animaux dans les Temps Géologiques, Paris, 1888.

Topinard, Paul, L'Anthropologie, Paris, 1876 (Presented by Mr. Toms, of the Brighton Museum).

Besides the usual exchanges and periodicals there has been also acquired a work of local interest:—

Hudson, W. H., Nature in Downland.

These four works have been numbered 1341-4.

A large number of most valuable publications have been received from the United States Government and the Smithsonian Institute.

H. DAVEY, Junr.,
Hon. Librarian.

BOTANICAL SECTION.

Chairman—J. Lewis, F.R.H.S.

Secretary—T. Hilton.

Committee—Miss Cameron, Mrs. Crafer, J. H. A. Jenner, G. Morgan, L.R.C.P., G. Hickley, H. Edmonds, B.Sc.

At a Meeting of the Section on the 25th May, 1900, a Committee was appointed for the ensuing year.

One evening Excursion to Shoreham was well attended and successful.

T. HILTON, *Secretary.*

The following rather uncommon Plants have been added to the Society's Herbarium since last Report:—

Botrychium Lunaria (Moonwort Fern).	Dyke Hills.
Alopecurus bulbosus.	Cuckmere Valley.
Vicia Bithynica.	Cult. land, Stanmer.
Coriandrum sativum.	" "
Ranunculus fluitans.	Chichester Canal.
Œnanthe pimpinelloides.	Bosham.
Ultricularia vulgaris (Great Bladderwort).	Pevensey.
Calamagrostis lanceolata.	Hurstmonceux.
Peucedanum palustre.	"
Zanthium spinosum.	Kingston.
Leersia Oryzoides.	Amberley.
Lactuca virosa	"

METEOROLOGICAL REPORT.

The most prominent feature of the Meteorological Table printed on the opposite page is the excessively high temperature in the five months, July—November inclusive. In August the mean temperature was 6·1° higher than the average, and the excess above the average continued until the end of November. In the first half of the present year the temperature did not manifest much variation from the average.

The rainfall in the third quarter of 1899 was very deficient, and again in the months of March—May inclusive in the present year.

Official observations have been taken on behalf of the Brighton Corporation from 1877 onwards. The average annual rainfall for the 23 years, 1877-99, was 29·19 inches. Since 1887, with the exception of two years, there has been, as shown in the following table, a continuous deficiency below this average. In the 11 preceding years, the rainfall in three years only was deficient from the average (viz., 0·27 inches in 1883, 2·83 inches in 1884, and 0·29 inches in 1888).

Deviation from Average Rainfall (29·19 inches) of 23 years, 1877-99.

YEAR.	DEFICIENCY.	EXCESS.	ACCUMULATED DEFICIENCY.
1887	7·07	—	7·07
1888	1·03	—	8·10
1889	1·74	—	9·84
1890	5·58	—	15·42
1891	—	5·19	10·23
1892	2·72	—	12·95
1893	5·06	—	18·01
1894	—	2·76	15·25
1895	4·00	—	19·25
1896	1·35	—	20·60
1897	0·07	—	20·67
1898	8·78	—	29·45
1899	5·72	—	35·17

It is clear, therefore, that we have been passing through an unusually protracted dry cycle of years; and whether we have yet left it behind is uncertain.

ARTHUR NEWSHOLME.

TABLE I.

Month.		Temperature of Air during Month.			Relative Humidity of Air. Saturation=100.	Wind.									Rainfall.		Sunshine.	
						Number of Days of												
		Highest.	Lowest.	Mean.		N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.	Number of Days on which Rain fell	Amount collected in Inches.	Number of Sunless Days.	Number of Hours recorded.
July,	1899 ...	82·2	52·0	65·4	68	5	1	3	2	—	9	5	3	3	7	0·61	1	300·01
"	1877-99 ...	85·0	45·0	61·8	73										12	2·34	1	226·77
August,	1899 ...	89·4	50·2	68·2	65	4	6	12	2	—	1	4	1	1	5	0·63	0	319·69
"	1877-99 ...	89·4	44·3	62·1	75										13	2·40	1	216·50
September,	1899 ...	80·8	39·4	60·1	73	3	1	—	—	2	3	5	12	4	14	3·25	1	199·82
"	1877-99 ..	83·2	35·9	58·3	79										12	2 64	2	171·56
October,	1899 ...	63·4	37·2	53·5	81	1	3	11	2	2	3	1	6	2	11	1·77	5	162·18
"	1877-99 ...	73·0	29·5	51·6	78										16	3·94	6	125·15
November,	1899 ...	61·6	34·6	50·2	86	6	4	1	—	—	10	2	2	5	10	4·25	11	58·17
"	1877-99 ...	63·5	17·9	46·2	86										16	3·36	10	71·86
December,	1899 ...	54·4	24·0	39·2	86	5	5	5	1	2	4	3	2	4	18	2·31	13	53·08
"	1877-99 ...	69·4	17·6	41·7	83										16	2·67	13	56·22
January,	1900 ...	51·2	30·0	41·4	88	8	2	—	1	7	4	2	3	4	21	3·53	11	51·84
"	1877-99 ...	63·6	12·0	39·6	86										16	2·68	12	58·79
February,	1900 ..	56·0	20·6	39·7	88	5	5	3	2	1	5	2	2	3	19	5·33	10	74·24
"	1877-99 ...	58·0	17·4	41·2	81										13	2·01	7	89·39
March,	1900 ...	58·6	24·0	41·3	78	8	11	7	—	1	2	—	1	1	9	0·90	8	101·50
"	1877-99 ...	65·0	20·2	42·4	81										13	1·83	5	142·88
April,	1900 ...	68·0	29·6	47·9	75	3	7	2	2	—	6	2	1	4	13	1·09	2	181·75
"	1877-99 ...	75·4	28·0	46·9	81										12	1·82	3	176·66
May,	1900 ...	70·0	38·8	52·2	74	6	6	—	3	5	5	1	3	2	8	0·50	2	215·85
"	1877-99 ...	78·1	30·0	53·0	73										11	1·70	2	237·49
June,	1900 ...	79·0	49·0	59·9	76	1	4	—	1	1	12	9	1	1	14	2·41	2	237·93
"	1877-91 ...	85·0	37·0	59·3	72										12	1·80	2	227·14
Entire Year ...	...	89·4	20·6	51·6	78	55	55	44	16	21	64	36	40	34	149	26·58	66	1956·06
Average of	1877-99 ...	89·4	12·0	50·3	79										162	29·19	64	1800·41

Brighton and Hove Natural History and Philosophical Society.

TREASURER'S ACCOUNT FOR THE YEAR ENDING 13th JUNE, 1900.

Cr.

	£	s.	d.
To Balance in the hands of the Treasurer, 14th June, 1899	4	7	10
" Annual Subscriptions and Arrears to 1st October, 1899	10	0	0
" Annual Subscriptions to 1st October, 1900 ...	61	10	0
" Annual Subscriptions to 1st October, 1901 ...	0	10	0
" Annual Subscription of Associate	0	5	0
" Entrance Fees	3	0	0
" Overpaid	0	0	6
" Dividends on £100 $2\frac{3}{4}$ per cent. Consolidated Stock, for one year, to 5th April, 1900 ...	2	15	0
	£82	8	4

Dr.

	£	s.	d.
By Books and Periodicals	6	19	0
" Bookbinding	1	12	8
" Printing Annual Report and Abstract of Proceedings	11	18	6
" Printing and Stationery (General)	7	14	1
" Postages, &c. (General)	8	3	1
" Scientific Secretary, Honorarium for the current year	10	0	0
" Subscriptions to Societies	3	9	6
" Clerk's Salary	2	2	0
" Commission to Collector of Subscriptions ...	2	12	2
" Gratuities to Assistants at Museum	3	0	0
" Expenses of Meetings and Excursions	13	8	5
" Botanical Section Expenses...	0	13	6
" Altering Bookcase and Removing Books	1	6	0
" Cost of Lantern Screen	1	5	0
" Fire Insurance Premium for Books	1	1	0
" Balance in the hands of the Treasurer, 13th June, 1900	7	3	5
	£82	8	4

Balance in the hands of the Treasurer, 13th June, 1900 £7 3 5

There is a sum of £100 $2\frac{3}{4}$ per cent. Consols invested in the names of the Hon. Treasurer and Hon. Secretaries, as Trustees for the Society.

Audited and found correct, 25th September, 1900,

SAMUEL COWELL, } *Hon.*
J. W. NIAS, } *Auditors.*

RESOLUTIONS, &c., PASSED AT THE ANNUAL GENERAL MEETING.

After the Reports and Treasurer's Account had been read, it was proposed by Mr. J. P. SLINGSBY ROBERTS, seconded by Mr. PANKHURST, and resolved—

> "That the Report of the Council, the Treasurer's statement (subject to its being audited and found correct), and the Librarian's Report be received, adopted, and printed for circulation as usual."

The Secretary reported that in pursuance of Rule 25 the Council had selected the following gentlemen to be Vice-Presidents of the Society for the ensuing year—

> "Mr. J. E. Haselwood, Dr. A. Newsholme, Mr. D. E. Caush, Mr. E. J. Petitfourt, B.A., F.C.P., Mr. J. P. Slingsby Roberts, Dr. E. McKellar, Dep. Surg. Genl., J.P., Mr. A. G. Henriques, J.P., and Mr. W. J. Treutler, M.D."

And that in pursuance of Rule 42 the Council had appointed the following gentlemen to be Honorary Auditors—

> "Mr. J. W. Nias and Mr. S. Cowell."

The Secretary also reported that the following gentlemen who had been elected Chairmen of Sections would, by virtue of their office, be Members of the Council—

> "*Botanical Section:* Mr. J. Lewis; *Microscopical Section:* Mr. D. E. Caush; and that the following gentlemen who are Secretaries of Sections would also, by virtue of their office, be Members of the Council:—*Botanical Section:* Mr. T. Hilton; *Microscopical Section:* Mr. W. W. Mitchell."

It was proposed by Mr. D. E. CAUSH, seconded by Surg. Genl. McKellar, and resolved—

> "That the following gentlemen be Officers of the Society for the ensuing year:—*President:* Mr. W. C. Wallis; *Ordinary Members of Council:* Dr. A. H. Dodd, Mr. Harrison, D.M.D., Mr. J. Lewis, F.S.A., C.E., Mr. F. R. Richardson, Dr R. J. Ryle, Dr. E. Hobhouse; *Honorary Treasurer:* Mr. E. A. T.

Breed; *Honorary Librarian:* Mr. H. Davey, Jun.; *Honorary Curators:* Mr. H. S. Toms and Mr. T. Hilton; *Honorary Secretaries:* Mr. Edward Alloway Pankhurst, 3, Clifton Road, and Mr. J. Colbatch Clark, 64, Middle Street; *Assistant Honorary Secretary:* Mr. H. Cane."

It was proposed by Surg. Genl. McKellar, seconded by Mr. E. A. T. Breed, and resolved—

"That the sincere thanks of the Society be given to Dr. W. J. Treutler for his attention to the interests of the Society as its President during the past two years."

It was proposed by Mr. S. Cowell, seconded by Mr. Slingsby Roberts, and resolved—

"That the sincere thanks of the Society be given to the Vice-Presidents, the Council, the Honorary Librarian, the Honorary Treasurer, the Honorary Curator, the Honorary Auditor, and the Honorary Secretaries, for their services during the past year."

On the motion of Mr. Pankhurst, seconded by Mr. Breed, the following alterations of the Rules were made—

Rule 33. "That the words 'at the close of such Meeting' be substituted for the words 'at the opening Meeting of the Session in October' in this rule; and that the following paragraph be added, viz.: 'At the close of the Annual General Meeting in June, the newly elected President shall be introduced to the Meeting, and at the opening Meeting of the following Session he shall deliver his inaugural address.'"

Rule 45. "That the last paragraph be omitted."

The effect of the proposed alterations will be that the President and Office bearers of the Society will enter upon their duties immediately after election instead of as now at the opening Meeting of the Session in October.

SOCIETIES ASSOCIATED,

WITH WHICH THE SOCIETY EXCHANGES PUBLICATIONS,

And whose Presidents and Secretaries are *ex-officio* Members of the Society :—

British Association, Burlington House, Piccadilly.
Barrow Naturalists' Field Club.
Belfast Naturalists' Field Club.
Belfast Natural History and Philosophical Society.
Boston Society of Natural Science (Mass., U.S.A.).
British and American Archæological Society, Rome.
Cardiff Naturalists' Society.
City of London Natural History Society.
Chester Society of Natural Science.
Chichester and West Sussex Natural History Society.
Croydon Microscopical and Natural History Club, Public Hall, Croydon.
City of London College of Science Society, White Street, Moorfields, E.C.
Department of the Interior, Washington, U.S.A.
Eastbourne Natural History Society.
Edinburgh Geological Society.
Epping Forest and County of Essex Naturalist Field Club, West Ham Institute.
Folkestone Natural History Society.
Geologists' Association.
Glasgow Natural History Society and Society of Field Naturalists.
Hampshire Field Club.
Huddersfield Naturalist Society.
Leeds Naturalist Club.
Lewes and East Sussex Natural History Society.
Maidstone and Mid-Kent Natural History Society.
North Staffordshire Naturalists' Field Club & Archæological Society.
Nottingham Naturalists' Society, Hazlemont, The Boulevard, Nottingham.
Peabody Academy of Science, Salem, Mass., U.S.A.
Quekett Microscopical Club.
Royal Microscopical Society.
Royal Society.
Smithsonian Institute, Washington, U.S.A.
South-Eastern Union of Scientific Societies.
South London Microscopical and Natural History Club.
Société Belge de Microscopie, Bruxelles.
Tunbridge Wells Natural History and Antiquarian Society.
Watford Natural History Society.
Yorkshire Philosophical Society.

LIST OF MEMBERS

OF THE

Brighton and Hove Natural History and Philosophical Society,

1900.

N.B.—Members are particularly requested to notify any Change of Address at once to Mr. J. C. Clark, 64, Middle Street, Brighton. When not otherwise stated in the following List the Address is in Brighton.

ORDINARY MEMBERS.

Abbey, Henry, Fair Lee Villa, Kemp Town.
Asher, Rev. F., 33, Clifton Terrace.
Ashton, C. S., 3, Chatsworth Road.
Attree, G. F., 8, Hanover Crescent.

Baber, E. C., M.B., L.R.C.P., 46, Brunswick Square.
Badcock, Lewis C., M.D., M.R.C.S., 10, Buckingham Place.
Bevan, Bertrand, Withdean.
Billing, T., 86, King's Road.
Black, R., M.D., 14, Pavilion Parade.
Booth, E., 53, Old Steine.
Breed, E. A. T., 32, Grand Parade.
Brooks, J. W., West Cott, Surrey.
Brown, J. H., 6, Cambridge Road, Hove.
Bull, W., 75, St. Aubyn's, Hove.
Burrows, W. S., B.A., M.R.C.S., 62, Old Steine.
Burchell, E., L.R.C.P., 5, Waterloo Place.

Cane, H., 64, Middle Street.
Caush, D. E., L.D.S., 63, Grand Parade.
Clark, J. Colbatch, 64, Middle Street.
Clark, F. G.
Couchman, J. E., Down House, Hurst.
Cowell, S., 16, Alexandra Villas.

Cowley, E. R., 12, Stanford Avenue.
Cox, A. H., J.P., 35, Wellington Road.

Davey, Henry, J.P., 82, Grand Parade.
Davey, Henry, Junr., 82, Grand Parade.
Deedes, Rev. Canon, 2, Clifton Terrace.
Denman, S., 26, Queen's Road.
Dodd, A. H., M.R.C.S., L.R.C.P., Church Road, Hove.
Douglass, F., B.Sc., 14, Clifton Terrace.
Draper, Dr., Municipal School of Technology.

Edmonds, H., B.Sc., Municipal School of Technology.
Elgee, E., Mountjoy, Preston Road.
Ewart, Sir J., M.D., F.R.C.P., M.R.C.S., F.Z.S., Bewcastle, Dyke Road.

Fletcher, W. H. B., Bersted Lodge, Bognor.
Friend, D. B., 77, Western Road.

Graves, A. F., 35, Southdown Avenue.
Griffith, A., 59, Montpelier Road.
Grove, E., Norlington, Preston.
Gunn, E. S., 95, Freshfield Road.

Hannah, I., The Vicarage.
Hack, D., Fircroft, Withdean.
Haines, W. H., 24, Hampton Place.
Hall, Craig, Mayfair, The Drive
Hardcastle, S. B., 71, East Street.
Harding, N., Wynnstay, Stanford Avenue.
Harrison, W., D.M.D., 6, Brunswick Place, Hove.
Haselwood, J. E., 3, Richmond Terrace.
Haynes, J. L., 24, Park Crescent.
Henriques, A. G., F.G.S., J.P., 9, Adelaide Crescent, Hove.
Hickley, G., 92, Springfield Road.
Hilton, T., 16, Kensington Place.
Hobbs, J., 62, North Street.
Hobhouse, E., M.D., 36, Brunswick Place, Hove.
Holder, J. J., 8, Lorne Villas.
Hollis, W. Ainslie, M.D., F.R.C.P., 1, Palmeira Avenue, Hove.
Horniman, F. J., M.P., Surrey Mansion, Eastern Terrace.
Howlett, J. W., 4, Brunswick Place, Hove.
Hurst, H., Ship Street.

Infield, H. J., 130, North Street.

Jennings, A. O., LL.B., 11, Adelaide Crescent, Hove.
Johnston, J., 12, Bond Street.
Jones, J. J., 49, Cobden Road.

Johnson, R. W. M., 21, Cheltenham Place.
Jacomb, Wykeham, 72, Dyke Road.

Knight, J. J., 33, Duke Street.

Langton, H., M.R.C.S., 11, Marlborough Place.
Law, J., The Wallands, Lewes.
Lewis, J., C.E., F.S.A., Fairholme, Maresfield.
Lewis, J., 37, Preston Road.
Loader, Kenneth, 5, Richmond Terrace.
McKellar, E., Deputy-Surgeon-General, M.D., J.P., Woodleigh, Preston.
Maguire, E. C., M.D., 41, Grand Parade.
Martin, C., 45, Montpelier Road.
May, F. J. C., 25, Compton Avenue.
Merrifield, F., 24, Vernon Terrace.
Mills, J., 24, North Road.
Mitchell, W. W., 66, Preston Road.
Morgan, G., L.R.C.P., M.R.C.S., 6, Pavilion Parade.
Muston, S. H., 54, Western Road.
McPherson, T., 4, Bloomsbury Place.

Newmarch, Major-General, 6, Norfolk Terrace.
Newsholme, A., M.D., M.R.C.P., 11, Gloucester Place.
Nias, J. W., 65, Freshfield Road.
Nicholson, W. E., F.E.S., Lewes.
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BRIGHTON AND HOVE

Natural History & Philosophical Society.

ABSTRACTS OF PAPERS

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INAUGURAL ADDRESS

BY

MR. W. CLARKSON WALLIS

(PRESIDENT), ON

"The Amateur in Science."

I DO not fail to remember, in taking this Presidential Chair, that it has been occupied in former years by Presidents of the Society, some of whom have distinguished themselves in scientific research, and others who, as members of learned professions, keeping in touch with the course and progress of discovery, have been able in their inaugural addresses to present an exhaustive *resumé* of the latest developments of science.

But I assume the honourable office, which by your courtesy has been conferred upon me, not in the capacity of one able in any degree to add to the sum of knowledge as these have done before me; but as representing those who are content, and who have to be content from the circumstances of their lives, or the extent of their abilities, to be simply amateurs in science. I use the word "Amateur" in the sense of one loving the pursuit, but following it without vocation, without fixed purpose, profiting by the labours and researches of others rather than his own. They are—

> "Pickers-up of learning's crumbs
> The not incurious of God's handiwork;"

or to use a word not perhaps euphonious but expressive, smatterers in science.

Whilst the membership roll of the Society embraces many who are well versed in scientific matters, there is, I believe I may say without undue depreciation, a large number who may be thus classed.

Cowper, in a too modest disclaimer of his right to assume the title of poet, describes himself as one—

> "Happy to roam among poetic flowers,
> Though poor in skill to rear them."

I now speak of those to whom, substituting the word *scientific* for

poetic, these lines may well apply; who find even such happiness in wandering with more or less purpose, sometimes aimlessly perhaps, amid the cultivated domain of intellect, gathering the blooms reared by the husbandmen of the garden, or plucking at will fruit from the Tree of Knowledge.

What then is the place of such in the economy of the Realm of Mind?

Are they merely drones who take their share of the honey without contributing to the store?

Not entirely; for apart from the fact that they take their portion without impoverishing the workers, their position is not altogether a selfish one. For whilst it is the golden rule that the first duty of man as regards his fellow is to endeavour to contribute to his happiness and welfare, there is also a duty of happiness towards oneself, a cultivation of those faculties for enjoyment which all more or less possess, and which as they are developed in the individual go to swell the great volume of happiness in the community.

It will not be necessary here to argue in this connection, the direction in which the highest and noblest pleasure is to be sought, and the purest enjoyment to be obtained. No need to attempt to prove that they are attained to the fullest extent in the appreciation through the intellect, of beauty, order, perfection, obedience to law.

It is these qualities which it is the province of Natural Science to reveal; and as they are revealed, and the degree to which they are unfolded and appropriated, to that extent are gained some of the most valuable of intellectual advantages,—an inductive habit of thinking, a capacity for judging fairly of facts without which the world is without form and void; nay more, they produce a refinement and elevation of mind which it is impossible can remain a mere selfish acquisition.

Of the cultivation of the intelligence in such directions a sentence from the Duke of Argyle well applies:—"It is in seeing the resemblances, and in seeing the correlative differences of things, that all knowledge consists. This perception is the raw material of thought—it is the foundation of all intellectual apprehension."

So the man of science by patient search and with unremitting toil extracts from the innermost recesses of the treasure-house of Nature a wealth of knowledge which he at once places at the disposal of all who will take it,—to the extent that they can take it,—to their own enrichment.

The ancient sage depicts, in one of the loftiest passages of oriental imagery, a sublime impersonation standing and crying aloud, inviting the uninstructed to share her bounty:—

"Doth not Wisdom cry,
And understanding put forth her voice?

In the top of high places by the way,
Where the paths meet she standeth ;
Beside the gates, at the entry of the city ;
At the coming in at the doors she crieth aloud ;
Unto you, O men, I call.

* * *

Hear, for I will speak excellent things ;
And the opening of my lips shall be right things,
For my mouth shall utter truth,
Hear instruction, and be wise.
Happy is the man that heareth me,
Watching daily at my gates,
Waiting at the posts of my doors."

Such is the attitude of the genius of Science, offering with unstinted liberality, one may say with prodigality, the wealth of her wisdom to all who can appreciate its worth, and will accept it at her hands.

In the domain of social economy, the disposal of commodities of various kinds requires the co-operation of the producer, the distributer, and the consumer.

Without pressing the analogy too far, we find in the domain of science a similar co-operation existing, by which the laws and forces of Nature, the marvels of matter and of inorganic life, become revealed, interpreted, and enjoyed. There is the discoverer who, by systematic investigation, enunciates the great principles of natural science; there is the inventor who applies them mechanically for the necessities and utilities of life; and the lay individual,—our amateur, if you will,—to whom the knowledge and facts which are placed before him come as a contribution to his intellectual enjoyment, and an addition to the pleasure of his existence.

It is clear that the amateur will not advance the cause of science along the lines either of the discoverer or the inventor. The cause of science is advanced by the man of "one idea at one time." It is true there have been and are some few giants whose vast genius enables them to range unchallenged in every department; such are Darwin, Tyndall, Huxley, and others. But, generally speaking, the workers who leave their mark and materially add to the sum of knowledge are those who centre their investigations within certain limits, and often very narrow ones. They are, in fact, specialists, who devote years to the elucidation of a single problem, or in finding out all that can be known concerning a single species of plant or animal.

And, in the end, though their life-work, as far as science is concerned, may be included in a single monograph, it is to that extent a solid and indispensable gain, and knowledge on the subject has been advanced by a distinct stage which will not have to be traversed again.

But the end of science is not the miserly accumulation of

facts, stored in books, like a talent hid in a napkin. Applied to the circumstances of life, science becomes the most potent of all intellectual factors in promoting the wealth, comfort, and happiness of humanity. So universal are its applications that we are apt to forget how much we owe to science, because so many of its wonderful gifts have become familiar parts of our everyday life, and their very value makes us forget their origin.

The infinite variety of methods of locomotion and communication; the aids to the manufacture of every detail of food, clothing; the furniture of houses; the development of arts and commerce; the preservation of health and the eradication of disease; the production of means for pleasure, recreation, education, and ten thousand other things, are the direct results of scientific invention and discovery. If we take up the most unconsidered trifle and trace its history, we shall be led back to some scientific basis, the discovery of which was in itself a triumph.

There is not a force in nature, nor scarcely a material substance which we can employ which has not been the subject of numerous original experimental researches, many of which have resulted, in a greater or less degree, in opening up fresh fields for employment and commercial activity. Therefore, says Archdeacon Farrar, "in the achievements of Science there is not only beauty and wonder, but also beneficence and power. It is not only that she has revealed to us infinite space crowded with unnumbered worlds; infinite time peopled by unnumbered existences; infinite organisms, hitherto invisible, but full of delicate and iridescent loveliness; but also that she has been, as a great Archangel of Mercy, devoting herself to the service of man. She has laboured, her votaries have laboured, not to increase the power of despots or add to the magnificence of courts, but to extend human happiness, to economise human effort, to extinguish human pain.

* * * *

On these and all other grounds I think (continues Farrar) that none of our sons should grow up wholly ignorant of studies which at once train the reason and fire the imagination, which fashion as well as forge, which can feed as well as fill the mind."

From the consideration of the highest and noblest missions of science, which have transformed the social and commercial conditions of the life of the world, our thoughts are thus turned to its effect upon the bulk of mankind as a means for opening the mental eye to see and to ear to hear. Without its continual aid, the individual mind, as well as the mind of the community, would relapse into a condition of confused superstition, "in wandering mazes lost."

The ordinary mind, untrained in science, is, to a great extent, the mind of a child. The child's mind is filled with

wonder at all that dawns upon it; imagination takes the place of certainty of knowledge, and fills the unknown with mental creations. Poetry occupies the place of prosaic fact, for poetical expression is the natural language of emotion, and there is nothing that excites the emotions of the mind as do the beautiful and awe-inspiring works of Nature.

Said a little fairy four-year-old to me the other day, pointing to a radiant cloud, "Is that where the sunshine lives?" A story is told of a little negro girl who thought that "the stars were gimblet holes in the floor of heaven to let the glory through." Natural, spontaneous poetry this; not perhaps of the exquisite finish of Shakespeare's:—

> "Look how the floor of heaven
> Is thick inlaid with patines of bright gold;"

but nevertheless equally the language of the emotion of the mind.

The child to-day imagines the copse at the bounds of the home-garden to be inhabited by wood-sprites; and the field half-a-mile away to be peopled by fairies and elves, and a cave is always an abode of awful mystery.

A fuller knowledge, when it comes, will disillusionize the child, will dispel the childish fantasy and replace it with solid fact, and, perhaps,—not a little disappointment.

What the child is, such are nations in their infancy; and, like the child, they have their growth in knowledge and their disillusioning. Pascal in his "Pensées" says:—"The whole human race in its development through a long series of ages must be regarded but as a man who lives perpetually and learns continually."

In the beginnings of nations, the forces and aspects of Nature so little understood, or rather so much misunderstood, offered nothing but a field for imagination. Peering into the unknown they peopled the world with fancy; phenomena for which the undeveloped mind could offer no natural explanation, were regarded as the outcome of occult agencies or the handiwork of superhuman beings. Their superstitions had as a root a belief in Animism by which the savage saw life in every object, animate or inanimate as the child sees life in the doll with which it plays. Animals, and even stocks and stones, were supposed to have souls, and why should they not have some mysterious power of helping or of hurting him? And thus the idea gradually grew of the advisability of propitiating the unseen by worship and sacrifice.

"From such rude beginnings we see nations as they advance in civilization rising to higher conceptions, developing the ghosts into gods and confining their operations to the greater phenomena of Nature, such as the sky, the earth, the sea, the sun, the stars, storms, thunder, and the like. And by degrees the unity of

Nature begins to be felt by higher minds, priestly castes are established who have leisure for meditation; ideas are transmitted from generation to generation; and the vague and primitive Nature worship passes into the phase of philosophical and scientific religion."

Science thus pushes farther and farther back the limit of the mysterious and reduces to commonplace truth the poetic vagueness of mythic lore.

To the ancient Greek the travellers' tales, brought back by early explorers from the bounds of the known world, contained descriptions of natural marvels (exaggerated, no doubt), for the explanation of which nothing would suffice but the intervention of a god or a demigod. Wonders but half seen, or but heard of by report, were woven into legends which were well-believed; but they are instances which show that, where no solid understanding of fact existed, there was the region for poetic fancy, or fancy which from its natural origin took a poetic form. And so the imposing rock masses at the entrance of the Mediterranean, in description at any rate, seemed like the pillars of a gateway, which none but Hercules could have fashioned.

Nor is it difficult, as another instance, to trace the origin of the notion of the Centaur. Commencing with the fact of the national custom or sport of bull-hunting in Thessaly, the expert horsemen who engaged in it evidently made a somewhat similar impression upon their neighbours as did the Spaniards upon the Mexicans who believed the horse and man to be one creature. Or at any rate as the story of the prowess of the Thessalian mountaineers came as a hearsay marvel to an imaginative people, the Centaur monster would be easily evolved. The adventures of Ulysses also abound with instances where natural phenomena evidently gave rise to mythical ideas.

Northern Europe, with its dull and cloudy skies, strangely impressive to the denizen of the sunlit south, became pictured to imagination as a region where Helios never revealed himself, and the phrase "Cimmerian darkness" still remains to testify of the myth. Again, the awful mystery connected with a volcano would, with the greatest naturalness, be connected with plutonic operations; and that Etna should be regarded as the home and forge of Vulcan is easily understood.

Nor need we go back to primeval or classic times to discover the tendency of the mind to allow the imagination to run riot where it is not held in check by the rigid regulation of Science. Medievalism, of course, abounds with instances, in fact, the very life of that time was saturated with superstition and speculation. There is something particularly *naive* in the manner in which ancient maps pourtray the regions beyond the limits then actually known, and in the impossible monsters, human and bestial, which figure, in all seriousness, in books of natural history.

Flint implements and celts were then regarded as thunder-

bolts which had fallen from the sky, or were even the bolts by which Satan and his angels had been driven into the abyss. This thunderbolt theory is common to many countries, nor is it extinct in our land even to-day; where masses of iron pyrites and fossil belemnites are very ordinarily supposed to be genuine thunderbolts. I cannot resist quoting a particularly choice specimen of "thunderbolt" lore, which is recorded in Tylor's "Early History of Mankind," and referred to by Laing. One Tollius, in 1649, thus describes some figures of stone axes and hammers:—"The naturalists say they are generated in the sky by a fulgurous exhalation conglobed in a cloud by the circumfused humour, and are, as it were, baked hard by intense heat, and the weapon becomes pointed by the damp mixed with it flying from the dry part, and leaving the other end denser, but the exhalations press it so hard that it breaks out through the cloud and makes thunder and lightning."

This seems to be a specimen of science as it was taught, or, at any rate, learned in England 250 years ago. The innate love of the marvellous fostered such speculations and superstitions,—and yet, through it all, there was a feeling after truth. And as, piece by piece, the truth is arrived at, and Science lays the firm foundation upon which the fabric of increased knowledge shall rise, ancient systems are destroyed, impossible figments of imagination are dispelled, old ideas change, and sober thought and rational proof take their place.

"The old order changeth, yielding place to new."

The process of being disillusioned is, however, not always an agreeable one. It is not always an easy thing to divest oneself of notions and beliefs which have been a part of one's very nature. Pioneers in Science in all ages have found this to their cost in their efforts to replace the false with the true, and Galileo and Roger Bacon in their prisons, and Giordano Bruno at the stake, were martyrs to their testimony for the truth.

Besides, there is something of a sense of humiliation in having to renounce opinions which have been held as verities, from which there was no appeal.

Imagination, too, has its roseate hues; and its vague possibilities have a real and definite charm which it is hard to relinquish. But Science is inexorable, and, to the open mind, the most cherished preconceptions have to fall before invincible truth.

But whilst Science is thus *destructive* towards that which is founded on error, she is *constructive* concerning that which is true, and not only so, but whilst she uproots the source of a pleasure that is merely poetic, sensuous, æsthetic in its relation to Natural Science, she implants a pleasure which is intellectual, and a capacity for appreciating the beauty and order of Nature;

and after all the real causes of natural phenomena are far more striking and contain more real poetry than those which have occurred to the untrained imagination of mankind.

These remarks show that true science having replaced unsystematic speculation with a solid basis of fact, whether in the mind of a child, the uninstructed national mind, or the individual mind, there is established a means for the opening out of every mental faculty.

This, then, is the position of the Amateur; and as the principles of Natural Science become apprehended, it is like the uplifting of a veil, by which the whole being is quickened as it perceives, in however small a measure, the order, law, and beauty in Nature, and in beholding, becomes a lover of them.

Whilst, therefore, the awakened mind of the amateur may not *discover* in the sense of adding to the aggregate of human knowledge, yet the habits of observation being stimulated, enable him to make research on his own account and for his own benefit.

Though he enters into an inheritance of garnered knowledge his own efforts will add to its value to himself by compound interest.

"Science," said a Royal Commission in 1861, "quickens and cultivates directly the faculty of observation, which in very many persons lies almost dormant through life, the power of accurate and rapid generalisation and the mental habit of method and arrangement; it accustoms young persons to trace the sequence of cause and effect; it familiarizes them with a kind of reasoning which interests them and which they can promptly comprehend; and it is perhaps the best corrective for that indolence which is the vice of half-awakened minds, and which shrinks from any exertion that is not, like an effort of memory, merely mechanical."

So much has the value of science become recognized in these respects, that, as we all know, of late years science has been an accepted part of the curriculum of schools of all grades, and received every encouragement possible from the government. To the rising generation education in Natural Science is therefore not so much a luxury as a school task.

At least it must be so if the teaching of it is simply a "subject" in the technical sense of the Education Code. It is not in this way that naturalists are made. It is not so much a matter of *knowing* as of *loving*, and the charms of Nature are not to be found by simply regarding her as one might a beautiful creation in marble, but as a companion, instinct with the breath of life. When, therefore, the youth leaves his school it must be borne in mind that his education is but begun, and it is then that societies, clubs, or other means to encourage him to continue his studies, not so much in a theoretical way as in an experimental, will be of great assistance to

him. Because, although not one in ten thousand may develop into a man of science as a profession, the inestimable advantages of some training in Natural Science which we have alluded to, will be worth having. He may, at any rate, develop into an amateur of science and a lover of Nature to his own profit and pleasure and to others as well.

If I may be permitted an allusion to my own personal experience, I should like to recall my own schooldays. At that time it was somewhat unusual to introduce the study of Natural History otherwise than in a strictly scientific manner, but with us every encouragement was given to engage in Natural History pursuits in the most practical ways. The effect has been very noticeable, for although it may be that but very few of my old schoolfellows have attained to anything like distinction, yet to the majority the habits of observation then gained, together with the actual knowledge acquired, have been of incalculable benefit in after years.

I do not propose to offer any challenge to advocates of athletics, but I have still a vivid recollection of the delights of those Saturday afternoon rambles, the popularity of which was testified to by a depleted football or cricket field.

In charge of a senior boy, little groups would start off at the earliest moment, well provided with shell scoops, butterfly nets, plant tins, and other naturalists' *impedimenta* (to say nothing of exuberant enthusiasm), bound for the various happy hunting grounds within a radius of five miles or more. O, what treasures did that muddy ditch or stagnant pool yield, in the shape of aquatic coleoptera; what entomological rarities that treacled tree; what a botanical Eden was Askham Bog!

Then came the excitement of the return home and the discharge of the various spoils in the class-room specially set apart for the purposes of the arrangement and the preservation of specimens. The strange and mingled odour of that place still abides as a vivid memory, and when one day, after all these years, I encountered a similar complex effluvium, by association the joys of those schoolboy explorations again came vividly before my mind. Nor was it only in collecting that the interest of these boys was manifested; but I remember the diaries of observations which were compiled, and the exhibition at the end of the term, where the specimens, duly arranged and described, were displayed in a manner educational in a high degree.

In after years for most of us engaged in commercial or professional life the opportunities for pursuing Natural History have become very limited, and one's reading in these lines, discursive and unsystematic,—somewhat of the "Science Siftings" type,—but with this groundwork laid, it is still possible to keep in touch with the progress of Science and to feel a sympathetic thrill at each advance which is made.

What fascination even a smattering in Geology has ! Geology is a branch of science, which above all others, perhaps, lends itself as a suitable pursuit to the amateur. Independent of seasons, capable of being studied in any locality, and though not necessarily requiring much knowledge in other branches, at any rate at first, yet with affinities in almost every other branch of science,—biology, botany, chemistry, mathematics, and the like. With such information as may be readily picked up, the railway cutting, the quarry, the hillside, the shore, every scarp and bank becomes instinct with meaning.

In early manhood it was my lot to live for a time on the coast of Durham. Much of the landscape is bare and uninteresting, marred by the gaunt machinery of the coalpits, from which extend the long, hideous banks of shale and spoil from the mines, stretching into the fields like lava streams from the crater of a volcano. But to this day I cannot recall to mind, without the revival of the feeling of keen pleasure, the leisure hours spent in exploring the geologic wonders of that region. It was a great occasion when first I discovered (new to me, of course,) the boulder clay glacial deposit on the coast, the remains of the great ice-sheet, which streamed from the Cumberland mountains and the hills of upper Teesdale, and ground its way into the bed of the North Sea, where it met the vast glaciers of Scandinavia. How precious were the beautifully scratched and polished boulders of carboniferous limestone, of granite, or of other rocks, which I found embedded in the mass, and which told such a marvellous story of the movements of the overwhelming mass of arctic ice ! And another day a wonderful raised beach of seaworn shingle and sand cemented into hard conglomerate came to light ; and then there were long afternoons on the shale banks amongst the fossils of the coal measures, or spent in examining the magnesian limestone, with its comparatively insignificant fossils, but which on acquaintance grew to be so interesting.

It is far from in an egotistical spirit that I refer to these experiences, but I present them as typical of what the pleasures of a mere scientific amateur may be. Others find equal charm in botany, of which I know nothing, and yet here may I give an example of the interest which only a very slight observation may give.

It is well-known that one of the botanic specialities of the County of Sussex is the somewhat insignificant *Trifolium Stellatum*. I had seen a single specimen, carefully preserved, from the shingle bank at Shoreham, the sole habitat in Britain of this plant, and where its seed is suspected of having been brought in ships' ballast. But when in Sicily this year I found it growing in profusion, there seemed a special interest to be attached to it.

It is, therefore, surprising how a comparatively small degree of knowledge gives an insight by which Nature is

transformed and beautified, not, of course, objectively, but subjectively. It is an *e-ducation* in the sense of the derivation of the word, that is in the sense of *leading out* the faculties to perceive and observe.

A lesson or two in the art of mixing colour on the palette will give a wonderful appreciation of hue in Nature and in Art, and in like manner a few well-directed hints of a scientific man give to the less instructed a line of direction in which he may pursue his own researches with much profit.

So the lecture to which we listened a few months ago by Mr. Enoch has invested the aphides of my garden with a romantic interest which my gardener scarcely appreciates.

With such education in Natural History a charm is given to a country walk which is indescribable. Sit on a hillside or a wayside bank, and peer into the mazes of grass and herb, and you are translated into another world, teeming with life into the concerns of which you seem to be able in measure to enter. The vagaries of a single ant will keep your attention occupied for half-an-hour, especially if you have had an introduction to the manners and customs of his kind through Lubbock's book. Then a bee appears upon the scene, and a fresh line of thought is started, or a spider commences his web-building operations and again diverts your admiration.

So much of real pleasure can be thus experienced by simple observation, that one hesitates to refer to specimen collecting which, after all, if not systematically done is of very doubtful advantage. To most of us amateurs the days of collecting are past, though probably with us all there has been a phase of our experience when we were possessed with a passionate desire to collect everything that pleased us. It was with something of the motive, and had something, too, of the melancholy result, which is said to have prompted the Afridis when they killed a descendant of the Prophet in order that they might worship at his tomb. But of course a collection without system and proper classification and nomenclature becomes simply a mass of mere rubbish, which it is a sorrow to possess. And after all, with good museums so accessible, there seems but little need to attempt to collect such objects as may better be seen in them. And to the naturalist, however limited his studies, the museum ceases to be a "valley of dry bones," for he finds that when Science prophesies, as in the vision of old, these dry bones can live.

But I feel I must not further weary you in pursuing the subject of the endless vistas which open up to seeking minds in the region of scientific investigation. Very much might be said as to what foreign travel presents to such, not simply as a matter of "tours" and "trips," but as veritable explorations and voyages of discovery, but time will not allow.

Thus the true lover of Nature need never be dull, because for him there is always at hand a feast satisfying alike to the

mind and to the eye, with the further gratifying knowledge that, however much he takes for himself, there is always as much for everyone else. This brings about a kind of freemasonry amongst all who are like-minded, and this fact alone opens up further means for enjoyment.

There is the charm of congenial conversation, the interchange of ideas and the gratification of finding points of contact with others in mutual interests. And perhaps not the least is found in the imparting of what knowledge one may have to those who have less, and in feeling that one is kindling fresh interests in another mind.

May I, therefore, lay before the members to-night my sincere conviction that one of the most important functions of our Natural History Society is here indicated, and that the inclusion in its ranks of a goodly band of Amateurs in Science is its glory, and one of its most valuable and beneficent operations.

It is vain to suppose that, save for a few exceptions, that they can, by original research, add materially to the accumulated total of knowledge, or that they can come into competition with the professor on his own ground. In science, as well as in art, the rate of progress is becoming more and more rapid in an increasing ratio, so that the simple amateur is left hopelessly in the rear. It is not for him to lead but to follow, and, under superior guidance and with sympathetic help, it is his joy so to do.

This consideration should not have a depressing influence upon the efforts of the amateur, although, in all his conclusions he may find himself forestalled. I can conceive the possibility of one having, with great labour, compiled a series of observations, offering the result in the shape of a paper to our Secretary, and receiving, in reply, a courteous inquiry if he were aware that the subject had already been exhaustively dealt with in a monograph by Professor Bumsterhausen, and that, after him, there was no more to be said.

But, from all we have seen, it is clear that it is not in these directions that the amateur finds his reward. Pope has said that "a little learning is a dangerous thing," which may be truth if the "little" should lead to presumptuous conceit; but, on the other hand, with diligence and humility, the "little" is of infinite value, for it is a solid basis on which to build more, and it is a practical truth that "to him that hath shall be given."

Nature has her high priests, but she has also her hosts of humble worshippers. And Nature becomes to her votaries, not a tyrannical goddess, but a kind and loving friend, with whom communion is a precious and lasting privilege; and as the years pass away her teachings become increasingly a present delight, and fill the mind with a store of happy memories.

TUESDAY, NOVEMBER 13TH, 1900.

The Ancient Beaches of Brighton and their Microscopical Contents,

BY

MR. FRED. CHAPMAN, A.L.S., F.R.M.S.

RAISED Beaches are among the most interesting phenomena with which the geologist has to deal. That they have been subjected to elevation above the present sea-level is clear from their relative position to modern sea-beaches, to which they are similar in structure; often consisting of shingle or subangular and rounded fragments of rock, which have been rolled and worn down by the tides, and accumulated in a bank above mean tide by the superior forces of spring tides and rough weather.

In a bay of considerable extent we may find at one end the piled-up shingle due to concentration of wave action against a steep shore; and at the other, where the shore has a gentler slope, finer material rapidly passing into fine sand which is often ripple-marked, owing to the currents abating in force. A section through a bed of this fine sand will sometimes show false-bedding, and sometimes horizontal stratification. We also find the conditions of a fine sandy area indicating deeper water.

The ancient sea-beach to be seen at Brighton, east and west of the town, was first brought under notice by Dr. Mantell, who described the sections seen in the cliff near Kemp Town (see "Fossils of the South Downs" and "Medals of Creation"). The extension of this ancient beach to Shoreham and Worthiug was recorded by Frederick Dixon, whilst Godwin Austin described a similar beach between Bognor and Bracklesham. A section taken along a line from the shore at Brighton to the chalk downs will show the Raised Beach forming a level platform or terrace until it ends against the foot of the chalk hills. This beach is in turn covered by a rather irregular layer of rubble-drift deposit. The hall in which we are now assembled is actually situated upon the Raised Beach.

Standing on the shore at Black Rock we can see the bed of rounded shingle pebbles with gigantic sarsen stones at the base,

resting upon the foundation of chalk, and following this to the east we find the old beach suddenly ends against the ancient sea-cliff which here nearly turns at right angles to the present cliff. At Black Rock there is an interesting occurrence of a fallen mass of chalk in the old beach. Tracing the old beach to the west of Brighton, through Hove to Portslade, the level gradually widens and the old sea-cliff recedes, until at Aldrington and Old Portslade the chalk cliff is a mile or so inland.

The recent excavations by the shore at Aldrington, where sand pits have been opened in the Raised Beach, have given geologists a good opportunity for examining these beds in detail.

By comparing these cliff exposures on the east and west of Brighton we can see that they are situated in different parts of the same bay, for at Aldrington the Raised Beach consists of 16ft of sand followed by about 6in. of pebbles; whilst at Black Rock we have only a few inches of sand, but about 10ft. of large boulders and rounded pebbles. Aldrington, in fact, stands on that part of the bay which at the time of the formation of the Raised Beach was a mile or so from the shore-line. This is further proved by the section at the brick pit near Portslade Station, where there is very little sand and 3ft. of beach pebbles.

In the sand bed at Aldrington marine shells are very common, chiefly the obtuse periwinkle (*Littorina obtusata*) and the mussel (*Mytilus edulis*). Both of these are found in shallow water, and prefer areas between high and low tides. The mussel shells are extremely fragile. In this case it appears to be due to the following cause. The shell consists of an inner nacreous and an outer fibrous layer. The nacreous portion which was of aragonite, has changed over into the stable condition of calcite, and in the process rough cleavage cracks were developed which has tended to make the shell rotten. A large subangular flint with many barnacles attached was found in the sand at this locality.

The white sand contains innumerable microzoa. Of the Ostracoda, the little bivalved Crustaceans, the species which lived during the accumulation of the sand of the Raised Beach are those which we find near the shore at the present day, with the exception of two forms which are more northern in their habitat. Six species of the genus *Cythere* were found here.

The carapaces of eight species of Ostracoda, which are known to live only in streams, ponds, and marshes, were found introduced into the sand of the Raised Beach, by fluviatile or even æolian agency.

A derived fossil microzoic fauna is also present, which is made up as follows:—

Two species of Wealden Ostracoda, which were probably introduced into the Raised Beach by a river draining the Weald, as the river Adur.

Seven species of Gault and Chalk Ostracoda, probably derived from the adjacent cretaceous beds.

Also a single specimen of a Tertiary Ostracoda was found in the sand of the Raised Beach, probably derived from an outlier of Lower Tertiary clays which at that period would be found resting on the chalk of the neighbourhood.

The contemporaneous Foraminifera, of which I found eight species, belong to the genera *Gaudryina*, *Truncatulina*, *Pulvinulina*, *Rotalia*, *Nonionina* and *Polystomella*.

There were also many derived chalk Foraminifera in the sand of this spot.

Throughout this sand bed are irregular seams of concretionary sandstone. These concretions vary from the most grotesque shapes to tabular layers. They were formed by percolating water charged with carbonate of lime, depositing calcareous matter around each granule of sand presumably as aragonite, which afterwards passed into the form of calcite. The sandstone does not derive all its calcite cement from the shells, for the latter are often found adherent to concretions, but certainly much of it has been derived in this way. When a piece of this sandstone is treated with hydrochloric acid, the residuum obtained is a fine sand exactly like the sand of the bed in which the concretions are found; it is composed of quartz and flint with an occasional sponge spicule derived from the chalk.

The top of the Raised Beach, at Aldrington, consists of a layer of well-rounded pebbles or small boulders resting on fine brown clay, in which are embedded the shells of mussels, &c. This clay, when washed, yielded a fine sand containing a large proportion of the heavier minerals, as zircons, rutile, tourmaline, kyanite and garnet. Some of the zircons are well crystallised, and show inclusions and gas cavities in the interior. All the microzoa found in this seam are indigenous to the deposit. A species of *Cythere*, one of the Ostracoda, and fifteen species of Foraminifera were also found in this brown clay.

There seems to be some evidence of intermittent ice action in these deposits. For instance, in places, the top of the sand beds show a wavy surface exactly like the trail of till and brick earth, and possibly indicates the stranding and melting of ice.

We scarcely have time here to discuss in detail the various theories of the elevation of beaches. The followers of Sir Charles Lyell maintain that the raised Beaches are evidence of the slow and steady movement of great land masses which form part of the gigantic folds seen in the formation of mountain chains. On the other hand, Professor Edward Suess has pointed out some serious drawbacks to the universal application of the theory of land elevation. One of these is the fact that Raised Beaches are often seen to overlie strata of very different hardness and struc-

ture, varying from soft clays to the hardest rocks. Since the ancient beaches are as a rule wonderfully horizontal in their present position, it seems hardly conceivable that land masses of such different structure could be so uniformly upraised. Suess believes that in many cases the level of the water has been lowered by earth movement or wrinkles affecting the ocean basins. A kernel of truth probably exists in both views, and the raising of the land and the lowering of the water level may at different periods have produced the same results.

We may see by a glance at a map showing the Raised Beaches of the south of England, that they are almost invariably situated on a foundation of some hard rock. Those which rested upon soft rocks have been cut back and entirely lost, the hard foundation of the others being their safeguard. We have already seen that at Brighton the Raised Beach rests upon Chalk. At Weymouth it has a foundation of Portland Limestone. The Raised Beach at Saunton, in Devon, is worth a few passing remarks. It is there found resting on the upturned edges of Upper Devonian Slates. At the base of the ancient beach, on the old waveworn surface of the slates, there are here and there along this part of the coast enormous boulders of granite. A picture of one of these is here shown which probably weighs about seventeen tons, and must have been carried by an iceberg to its present position. Above this Raised Beach there is an interesting deposit of false-bedded sands, rendered coherent by calcareous material, with included marine and land shells. This accumulation is of great thickness, often measuring 50ft., and representing ancient sand-dunes formed above high water mark, much in the same way that Braunton Burrows are now being formed. At Torquay and Baggy Point the Raised Beach is found again upon Upper Devonian Rocks. At Weston-super-Mare and at Gower, in South Wales, it is found on the Carboniferous Limestone.

In conclusion we may note the many coastal areas affected by recent upheaval or the reverse, in various parts of the world, and for a case lately brought before our notice this may be illustrated by the views taken by Mr. C. W. Andrews, of the elevated beaches and reefs of Christmas Island.

The Lecture was fully illustrated with a large number of Lantern Slides.

WEDNESDAY, DECEMBER 12TH, 1900.

An Evening for the Exhibition of Specimens & for Microscopes.

FRIDAY, JANUARY 25TH, 1901.

Among the Books:

BEING NOTICES OF THE MORE IMPORTANT WORKS IN THE COLLECTION PRESENTED TO THE SOCIETY BY Mr. J. E. HASELWOOD.

MR. HENRY DAVEY, JUN.

WEDNESDAY, FEBRUARY 13TH, 1901.

How Electricity is Measured,

With Experimental Illustrations.

MR. E. PAYNE, M.A.

TUESDAY, FEBRUARY 26TH, 1901.

Autocrats and Fairies.

MR. FRED ENOCK.

WEDNESDAY, MARCH 13TH, 1901.

The Pottery of Prehistoric and Roman Britain,

BY

MR. H. S. TOMS

(Acting Curator, Brighton Museum).

THE earliest chapters in the history of the potter's art in our country lie hidden in the obscurity of pre-historic times; and, as to the origin or introduction of this art into Great Britain, the evidence afforded is much too fragmentary to enable one to form any valid conclusion.

The first traces of the pre-historic potter consist of the few fragments of rude hand-made pottery occasionally found in the Long Barrows, or burial mounds, constructed by man during the Neolithic or latest period of the Stone Age.

STONE AGE POTTERY.—Of the pottery of the Stone Age but little is known owing to its extreme rarity. As far as I am able to ascertain, not a vestige of it has been discovered during the investigations of their flint mines and entrenchments. It seems solely confined to the burial mounds; in them it but infrequently occurs, and then, invariably, in a fragmentary condition. In the majority of instances, moreover, its position in the barrows leads to the supposition that its occurrence there is purely fortuitous, it being generally found either in the body of the barrow away from the primary interment or at the bottom of the ditch surrounding the barrow. These fragments, in all probability, constitute the remnants of the easily broken domestic vessels of the persons employed in the construction of the mound. The custom of burying pottery in any shape or form with the dead does not seem to have existed. Only one instance is known of a vessel being found in a fragmentary condition with the primary interment. This was discovered by Dr. Thurnam in a long barrow at Norton Bavant, Wilts. It is figured in vol. 42 of the "Archæologia," p. 194, from which I have made the full-size sketch I now exhibit.

Like all pottery of this period, it is hand-made, the paste containing small fragments of pounded shells. This latter ingredient and the method of manufacture are the principal characteristics of the Stone Age pottery.

Owing to its extreme rarity, but few museums are the fortunate possessors of these fragmentary relics of the Neolithic potter's art. However, through the kindness of a great friend, I am enabled to lay before you two pieces of this interesting ware. They were found with others lying underneath the previously undisturbed chalk silting on the bottom of the ditch of a long barrow on Handley Down, Dorset. Another fragment identical in quality to these was found near the primary interment; and, judging by the results of very critical tests afterwards applied by General Pitt Rivers to ascertain the rate of the disintegration of the sides of the ditch and the consequent accumulation of silting at the bottom, there seems no question as to their being of the same age as the barrow itself. Furthermore, I can personally vouch for their authenticity, as it was my good fortune to conduct the excavation of the barrow in question, and to be present during the whole time that the work was in progress.

METHOD OF MANUFACTURE.—In the endeavour to unravel the knotty problems which beset the scientist in his study of the arts and customs of prehistoric races, he has frequently found the elucidation of many obscure points by turning his attention to the study of savage life, and of the peoples who retain in their habits and arts the survivals from primitive ancestors. The value of this comparative study is well exemplified in the case of stone implements; and it may not be inopportune to adopt the same plan in dealing with the probable methods employed by the Stone Age race in the manufacture of their pottery This will also form an excellent preliminary to our consideration of the pottery of the succeeding period—the Bronze Age.

The material illustrations of hand-made pottery which I have selected from the museum collections for this purpose, are two Hebridean "craggans," and a pot made by West African savages in the Hinterland of Sierra Leone. The two former were actually used as late as 1896 by the inhabitants of the Hebrides. They were presented to the Museum by Mr. A. F. Griffith, and were obtained from crofts or huts near Barvas in the Isle of Lewis, N.B. Until thirty years ago there was little communication between these islands and the mainland; and, in their daily life, the inhabitants retained habits which were of the most barbaric simplicity. Time does not admit of anything like a description of this interesting people, so I must restrict myself to the consideration of their pottery.

It appears that the making of this class of pottery fell to the lot of the Hebridean women. The process of manufacture has been so well described by Dr. Sir Arthur Mitchell, that I cannot

refrain from quoting it at length. Whilst at Barvas in 1863, he engaged a woman to show him the whole process. He writes :—

"The clay she used underwent no careful or special preparation. She chose the best she could get, and picked out of it the sand and fine gravel which it contained. With her hands alone she gave to the clay its desired shape. She had no aid from anything of the nature of a potter's wheel. In making the smaller 'craggans' with narrow necks, she used a stick with a curve on it to give form to the inside. All that her fingers could reach was done with them. Having shaped the 'craggan,' she let it stand for a day or two to dry, then took it to the centre of the floor of her hut, filled it with burning peats, and built peats all round it. When sufficiently baked, she withdrew it from the fire, emptied the ashes out, and then poured slowly into it and over it about a pint of milk in order to make it less porous. The 'craggan' was then ready for use and sale.

"It is desirable at once to realise, with regard to these 'craggans,' that there is nothing in the way of pottery more rude. They are made of coarse clay containing sand and gravel; they are not baked in an oven, but in an open fireplace; they are shaped with the hands without aid from any sort of potter's wheel; they are unglazed, they are globular and without pediment; they are nearly always destitute of ornament, and such ornamentation as does occasionally occur on them is composed of straight lines made with a pointed stick or the thumb nail, or with a piece of cord. The rudest pottery ever discovered among the remains of the Stone Age is not ruder than this, and no savages now in the world are known to make pottery of a coarser character." ("The Past in the Present," p. 25-28.)

The other specimen to which I wish to draw your attention, was made in Mendiland, Sierra Leone, and was purchased together with a fine ethnographical collection from this district by the Corporation from Mr. T. J. Alldridge. In writing of his wanderings in the country of the Mendis, Mr. Alldridge states "pottery making is the great industry of the women, and very clever they are at it. With only a lump of clay from a neighbouring stream, a board, and a couple of cane modelling sticks, in a few minutes a woman will turn out for you a large and well-formed bowl." ("Wanderings in the Hinterland of Sierra Leone," "Geographical Journal," August, 1894, Vol. 4, No. 2, p. 139.) He does not mention how the pottery is baked. In the paste of this pot a large admixture of mica may be observed. Mr. Alldridge informs me that this was not intentionally introduced, but that mica forms a marked constituent of the greater part of the clays used by the Mendis in making their pots.

Many other different methods employed by savages in fabricating their hand-made pottery could be quoted; but the two examples just given are sufficient for my present purpose. Com-

paring these specimens with the sketch of the pot found by Dr. Thurnam and with the two fragments of Stone Age pottery, I think we may reasonably conclude the Neolithic potter must have given these productions a somewhat analogous if not a similar treatment in making them.

THE BRONZE AGE.—We now pass on to the time of the substitution of bronze tools for those of stone. Bronze tools appear to have been fabricated on the Continent long before the use of this metal was known in Britain; and its introduction to this country was due to the conquest of the Neolithic Iberians by the continental Celtic tribes among whom it was in common use. We have, also, ample proof afforded by archæological research that the transition from the use of stone tools to those of bronze was gradual, and that the Stone and Bronze Ages considerably overlapped each other.

The principal remains of Bronze Age man which exist at the present day are his burial mounds, his fortified camps, and the remnants of the pile-dwellings which he erected in lakes and morasses. The barrows or burial mounds, which are abundant, have received most attention from archæologists; and the study of the remains associated with the interments has shown the Bronze Age capable of being divided into an early and a late stage. The first was the transitional or overlapping period, when the stone tools were being superseded by wedge-shaped bronze axes originally modelled from a prototype in stone, and by bronze daggers. By far the greater number of the Bronze Age tumuli or barrows in this country belong to this early stage. The latter division is marked by the presence of swords, palstaves, socketed celts, and elaborate bronze ornaments.

POTTERY.—The pottery of the Bronze Age is of great interest. Our Museum possesses but three poor specimens, and I shall, for want of better illustrations, have to treat this period in a somewhat cursory manner. The majority of the best examples have been found associated with the interments in the burial mounds, and all specimens hitherto discovered are of the handmade type. From negative evidence we may therefore assume that the use of the potter's wheel was unknown to the Early Bronze Age Briton.

When considering the Stone Age we saw that inhumation was the chief mode of burial. In the Bronze Age, however, the prevailing custom was cremation, though burial by inhumation still obtained, such interments being by no means rare, and the bodies having been buried in a crouched or contracted posture as is the custom among so many savage races of to-day.

CINERARY URNS.—After the dead body had been consumed on the funeral pile, its ashes were carefully collected and placed in a special pot which we now term a cinerary urn; a grave was then made just large enough to contain the urn, generally in a

prominent spot on the Downs or on other high land ; as a rule a trench was next dug round the grave at a distance of some, 15, 20, or 30 feet from the interment, and the whole of the material got out of the ditch was thrown over the grave, and so the burial mound was formed.

These cinerary urns are of varying shapes and sizes, their capacities ranging from less than a pint to more than a bushel.

Incense Cups or Immolation Urns.—Very frequently small vessels of pottery which rarely exceed two inches in height are discovered with cremated interments; sometimes they are within the mouths of the larger cinerary urns, sometimes standing close by them, and at other times they are the only accompaniments of interments which have not been deposited in urns.

The probable use of these little vessels is a moot question. Many archæologists term them incense cups under the supposition that they were the receptacles of incense burnt at the time of the cremation of the body. The forms of some certainly suggest that they were used for the purpose of burning some substance or other, and it may be that the sacred fire was carried in them to ignite the funeral pile. As they frequently contain burnt bones, another view as to their use has been promulgated, to the effect that they were intended to receive the ashes of infants sacrificed at the death of the mother, hence the name Immolation Urns.

Drinking Cups.—Perhaps the highest class of the Bronze Age pottery consists of the so-called drinking cups found with interments of this period. When discovered they contain no substance other than the material in which they are buried. Many specimens, though, are stained or encrusted up to a certain level, and the opinion is that they contained some liquid placed with the dead. When these vessels are discovered with the crouched skeletons they generally occupy a position at the feet, as may be seen from the illustrations in the volumes of "Pitt-River's Excavations."

Food Vessels.—The so-called food vessels form another type of pottery principally accompanying unburnt bodies of this period. Like the drinking cups, they are usually found standing upright, and, where the mouths have been protected in such a way as to prevent any material falling into them, they are generally quite empty. Some, however, contain a little dirt or decayed organic matter, and they are supposed to have contained offerings of food placed with the dead. They are elaborately ornamented, even more so than the drinking cups. These two types of pottery, the drinking cup and the food vessel, seem, according to Dr. Thurnam's views, to have belonged to what we may term the table ware of the Bronze Age Britons.

Ornamentation. — Another interesting feature of the pottery of this period is the ornamentation which consists principally of patterns of dots and straight and curved lines.

The dotted patterns on many of the drinking vessels for instance appear to have been produced with a small piece of wood or bone. In ornamenting many of the larger cinerary urns, however, the point of the finger or thumb was used to make the required dots of indentation; and the study of this latter method led Dr. Thurnam to an interesting supposition. He states:—" So far as I have been able to compare the size of the digitations, they point to the inference that the makers of our British fictilia, like the potters of the existing American and African tribes, and lately even the Hebrides, were of the female sex."

The patterns in straight and curved lines are, as a rule, indented or incised, presumably with a pointed stick or bone, or by the impress of a twisted string of fibre or sinew.

Sun-Drying or Sun-Baking.—The early archæologists expressed a view that many of the rude vessels of this period which have come down to us were baked or dried simply by exposure to the rays of the sun; but such a view is utterly fallacious, for the experience of the modern potter shows that a temperature far in excess of our extreme summer heat is necessary to convert clay into pottery or terra-cotta, and so produce that chemical change in the clay which renders it, as pottery, the most durable of all manufactured substances.

Presuming the sun-drying process to have obtained among the Bronze Age Britons, then the percolation of water through the burial mounds would have resolved all such sun-dried specimens into their original clayey state, and this, combined with the varying temperature and other causes during the lapse of the intervening years, would have sufficed to crumble them to pieces, and none would have figured in our public and private collections to bear witness of the potter's art of these far-off times.

Camps.—Few perfect examples of Bronze Age pottery other than those associated with the interments of this period have been discovered; and the archæologist owes much to the interesting modes of sepulture of our prehistoric Celtic ancestors.

The entrenchments or fortified camps and the villages of the bronze-using Britons have, as yet, received scant attention in the way of methodical research. To my knowledge three only of these have been thoroughly investigated. These, all of the rectangular form, and situated in North Dorset, were excavated by the late General Pitt-Rivers. Previously to the excavation of these rectangular earth works the view held with regard to their age was that they were constructed during the period of the Roman occupation; and I remember having seen this opinion stated in more than one local publication with reference to Hollingbury Camp, which is rectangular, and I believe the majority of Brightonians, who are aware of its existence, still tenaciously hold to this opinion. For my own part I do not imagine I am too sanguine in anticipating that an investigation of this camp, and

that of Highdown—another similar camp on the hills west of Cissbury—if it does not prove them to be of the Bronze Age, will, at least, reveal them to be pre-Roman works.

The pottery turned up in the camps of this period, is, as one may well imagine, of a fragmentary character, consisting as it does of the thousands of the shards of easily-broken domestic vessels. The majority of the fragments so found are of the texture and quality of the cinerary urns and other vessels used for sepulchral purposes. This, and the fact of the discovery in the filling of the ditches of several nearly complete urns in a fragmentary state similar to those used for cinerary purposes, seems to militate against the generally received opinion as to the class of vessels found with interments being manufactured exclusively for mortuary purposes.

Iron Age.—The last phase of the prehistoric period with which we now have to deal is that lying between the introduction of the knowledge of the use of iron and the coming of the Romans in the first century B.C. In all probability this period was of short duration compared with that of the Bronze Age. Our knowledge of it is but scanty, and few examples of the pottery of this the early Iron Age have as yet been discovered. From the study of well authenticated remains, however, we gleam this much, namely, that the coast tribes of the south-eastern portion of Britain were in a variety of ways influenced by and had adopted many of the arts and customs of the Gauls who inhabited the neighbouring continental regions, and with whom they are in constant communication.

The Gaulish influence is most notable in the coinage as well as by the introduction of the potter's wheel, the use of which the continental tribes had probably derived by more direct contact with southern civilisation. This latter instrument enabled our prehistoric potter to impart grace and symmetry to his fictile productions, and its application is apparent from the forms of the majority of the best known examples of the so-called late Celtic pottery. The sketches I exhibit are of two such specimens found in Kent, and of the two discovered by General Pitt-Rivers in his excavation of the late Celtic pits in the interior of Mount Caburn Camp near Lewes. Mr. Park Harrison also found the fragmentary remains of two pots in similar pits dug by the tribes of the early Iron Age in the interior of Cissbury Camp. Fortunately these are in our Museum and are now exhibited, together with a very fine example of this class of pottery found at the bottom of Elm Grove during excavations for the foundations of a church. In shape, texture, and ornamentation, the latter closely resembles the specimens from Mount Caburn and Cissbury.

Roman Britain.—Having passed the prehistoric periods of Britain in rapid review, that now remaining to form the conclusion of my paper is the Roman occupation. The duration of this, I

may remind you, was, roughly speaking, about 400 years. This long interval saw the Romans deeply implanting the seeds of our first civilisation, and to their chroniclers of this eventful time we owe the first written records of the history of England. But these early writings, valuable as they are, are sadly incomplete ; and it is the spade of the antiquary which has added a very material complement to the knowledge which we gather from the perusal of classic authors.

Turning our attention to the pottery of Roman Britain, we find what an enormous influence was exerted by the Romans in this direction. Huge factories of pottery, extending over many square miles, were established in various parts of the island, in which thousands of persons were constantly employed ; and numerous small local potteries sprang into being wherever clay of a suitable quality was obtainable in the vicinity of Roman stations and Romano-British villages. The wares thus produced were of a very varied character, and an endless number of vessels were fabricated.

The sites of the principal potteries brought to light by the investigations of the archæologist are three in number, namely, the potteries near Sheerness in the Upchurch marshes on the banks of the Medway, those situated on the banks of the Severn in Shropshire, and those of the ancient city Durobrivae on the river Nen in Northamptonshire. The pottery from these districts exhibits different types and forms which are known respectively as Upchurch ware, Salopian ware, and Durobrivian or Castor ware. Similar wares are found scattered abroad all over the kingdom in connection with Roman and Romano-British remains, and it seems patent that the pots enamating from these centres formed an important trade item with these peoples, who used pottery for a variety of purposes which surpasses even that of the present generation. Further on we shall also see that pottery was imported from the factories of Continental Roman stations.

The marked superiority of the pottery of Roman Britain over that of the preceding barbaric times, becomes very evident when we examine even a fairly representative collection. Instead of the rude hand-made vessels which were baked in the open fire, we observe graceful and artistic forms which were moulded on a small revolving table or potter's wheel—the *orbis* or *rota figularis* of the Romans—and afterwards fired in properly constructed kilns. Many of these kilns in a perfect state of preservation have been laid bare on the sites of the principal potteries.

With such an array of pots and pans as that produced during the Roman occupation, a difficulty arises in selecting for description such examples as will be of service in a short account of this kind. Our attention, therefore, must be confined to the consideration of a few typical interesting forms and to local finds.

Samian —The most beautiful and artistic of the Roman pottery discovered in Britain is the so-called Red Samian. This was highly esteemed and extensively used, and formed the table ware of the Romans and Romano-British aristocrats. The forms of the Samian vessels are very varied ; some are unglazed, but the finer and more ornamental examples are coated with an extremely thin glaze which gives them the appearance of a dull-red sealing wax. The term " Samian " was applied to this ware by the Romans themselves, although the generally received opinion is that it had no connection with the island of Samos. Whether the red ware fabricated in the Greek islands formed the prototype of Samian, or whether it was invented by a person named Samos, still remains a matter of doubt.

Both the classic authors and recent researches prove that the principal factory of this ware was at Aretium in Italy—the modern Arezzo—from whence it was exported to the distant Roman colonies, and by sale and barter, found its way among the barbaric tribes far removed from the sphere of Roman influence both in Europe and Asia Minor.

The question as to the constituents of the clay used in its manufacture and of the material employed in glazing still remains unanswered. No similar clay has been discovered ; and it is thought the red colour was obtained either by an admixture of highly ferruginous clays or by the addition of oxide of iron and lead.

Many of the vessels are quite plain, but the majority are highly decorated in high relief with scenes from the chase, daily life, and subjects from Roman mythology, among which appear elaborate embellishments of foliage and ornament. The makers' names also appear on much of this class of pottery in the shape of small labels stamped on the bottoms and sides, as may be seen on examining several specimens now on the table.

In the fabrication of this ware, especially of the more ornamental, a clay mould in one or several pieces was used. When the mould was in a plastic state the scenes and embellishments were impressed round its interior by means of stamps. When the mould was ready for making a Samian vessel, the interior was coated with a clay of the desired thickness, which was then well modelled and firmly pressed against the sides of the mould in order to take the external designs in relief. This being satisfactorily accomplished, it was set aside till the vessel had become properly dry and had shrunk sufficiently to admit of its being taken bodily from the mould ; deficiencies were then rectified, and, if properly dry, the vessel was ready to be submitted to the fire of the potter's kiln.

A few fragments of these moulds have been discovered in England, but it is generally agreed that the Samian ware was not produced here, but that it was obtained either from Aretium or

from the Samian factories in Germany and France. The potters of Roman Britain did, however, endeavour to imitate this choice ware by the same process of moulding, but their productions in this direction were comparatively poor. This is known as false or imitation Samian, the red colour of which was produced by dipping the clay into a slip or thick clayey liquid made of sulphate of iron. It is probable that the fragmentary moulds discovered in England were used by the British potters in their attempts to imitate the true Samian.

The forms and composition of the pottery produced by the Romanized Britons are practically identical with that of the Roman potters. The distinguishing characteristics of the former consist mainly in the ornamental patterns which are in many cases similar to or survival of those on the pottery and other artistic productions of the prehistoric periods.

But, even with this as a criterion, it becomes a matter of great perplexity to lay down any hard and fast lines of distinction between the pottery produced by the Roman potters and that made by the Britons under the influence of Roman art.

As the greater number of our local specimens have been discovered associated with interments in the cemeteries of the Romans and Romano-Britons, a short description of the burial customs of these peoples becomes a necessity. Until the introduction of Christianity in the Third Century, cremation was prevalent among the Romans. The ashes of the dead were carefully collected from the remains of the funeral pile and placed in a special cinerary urn, or, when this was unobtainable, in some domestic vessel,* as may be seen in the examples before you. It was then carried to the local cemetery, which was invariably situated by the roadside outside the precincts of the town or important station, or, in the event of the death occurring in the country, to the burial ground in the immediate neighbourhood of the villa or hamlet. The urn containing the cremation was then often buried enclosed in a much larger vessel or in a coffin to protect it from the superincumbent earth. A number of vessels of different descriptions were sometimes interred with the one containing the cremation; these were probably used at the funeral feast or were intended for the use of the spirit of the deceased in the world of the departed.

The burial customs of the Britons seem to have undergone

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* At Wilderspool, an outskirt of Warrington, a great deal of interesting Roman pottery was discovered some years ago, among which were two *tetinae*, or feeding bottles. "When found the mouth of each was covered by a fragment of pottery, and from their upright position and contents, there can be no doubt that they contained the ashes of one or more children."—JEWITT, *Ceramic Art*, p. 41.

a great change under the influence of the Romans, and the most recent researches tend to show that comparatively little care was bestowed upon the dead of the poorer classes. In many cases the bodies are found pitched pell-mell into their refuse pits, an instance of which was exhumed not long since at Portslade, but sometimes an apology for a grave was made in the drains and ditches surrounding their villages and camps. The secondary interments in the barrows of the preceding periods also show that these were used as burial-places both by the Romans and Romano-Britons.

Broaching the subject of the fictile remains of the Romans and Romano-Britons in Sussex, we find that the more notable examples have been exhumed near Brighton, in the cemeteries in the neighbourhood of Portslade, the approximate site of the Portus Adurni* of the Romans, and at Seaford, Hassocks, and Hardham in West Sussex. Taking the pottery found by Professor Boyd Dawkins in the Romano-British cemetery at Hardham, we observe the majority of the vessels are of a dark-coloured ware. This colouring, together with the forms and ornamentation of several of the vessels, resembles the Upchurch ware, and the black colour is supposed to have been produced by merely smothering the fire of the kiln and so sending volumes of smoke through the chamber containing the pots in process of baking.

Another interesting discovery made at Hardham previously to Professor Boyd Dawkins' investigations, is the large amphora now before you. "With the exception of a coin of Hadrian, and another Roman coin, it contained nothing but a quantity of dark matter, which, in all probability, consisted of the ashes of the dead. Before it had been used for sepulchral purposes, it had lost the neck and handles, and a crack, which must have rendered it useless for holding wine, prevented from extending by two leaden rivets, was probably the cause of its being used to cover human ashes" ("Sussex Arch. Coll.," vol. xvi., p. 51). Of the other perfect amphora exhibited, all information has unfortunately been lost; it is probable, however, that it is a modern foreign production.

Another class of pottery figuring in our local collection is that known as the New Forest ware, owing to the discovery of its most typical forms at kilns in the New Forest. The two well-known kinds are the cream-coloured and the hard; the vessels of the latter division are usually decorated with fluted indentations made by the thumb or finger whilst they were in a plastic state. This ornamentation also occurs on specimens of the Castor ware.

Probably the most artistic little pot we possess from Portslade is that under the glass shade. It is a typical specimen of

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* Aldrington; Scarth, *Celtic Brit.*

the ornamental Castor ware, and is made from a fine white clay, and decorated with the figures of three dogs in high relief. These figures were not moulded after the manner of the Samian ware, but, when the pot had been plainly modelled on the wheel, a clay, of the same colour as the body of the pot, was prepared and diluted with water till it had attained the consistency of a thick cream ; the figures and other ornamentation in relief were then produced by laying on the slip or clayey liquid by means of small pointed sticks. The black colour of the surface of the vessel is, in all probability, due to the smoke of the kiln. In painting designs on pottery the Romans displayed little skill, the only ornamentation of this kind consisting of a slip of red, white, or yellow clay, put on with a brush in coarse bands or scroll patterns.

I have also brought forward for exhibition the fragmentary remains of a mortarium. This class of vessel was extensively used, if we may judge by the number found with Roman remains, and it is thought they were employed in the culinary department for pounding and beating up vegetables and other articles. My sketch shows the general form of these vessels.

Sussex is extremely rich in pre-historic remains. Few of the hill forts have been methodically investigated ; but, whenever such excavations are put in progress, the broken shards of pottery will form the most valuable evidence as to the periods of their construction and of subsequent occupation by other tribes and races.

And so, ladies and gentlemen, I think no apology is needed for this popular paper, in which I have overhauled the pots, bones, and dust-heaps of pre-historic and early historic times. In his admirable little book on "Evolution in Art," Professor Haddon states that "perhaps no manufacture is of such importance to anthropologists as pottery. Earthenware vessels are comparatively easy to make, and though they are brittle, their fragments, when properly baked, are almost indestructible. The history of man is unconsciously written largely on shards, and the elucidation of these unwritten records is as interesting and important as the deciphering of the cuneiform inscriptions on the clay tablets of Assyria." (p. 97.)

FRIDAY, APRIL 26TH, 1901.

DISCOVERY OF A

Mummied Toad in a Flint Nodule,

FOUND AT LEWES, SUSSEX.

(Now in Mr. Henry Willett's Collection, Brighton Museum.)

BY

CHARLES DAWSON, Esq.,

F.G.S., F.S.A., Etc.,

Honorary Member of the Brighton and Hove Natural History and Philosophical Society.

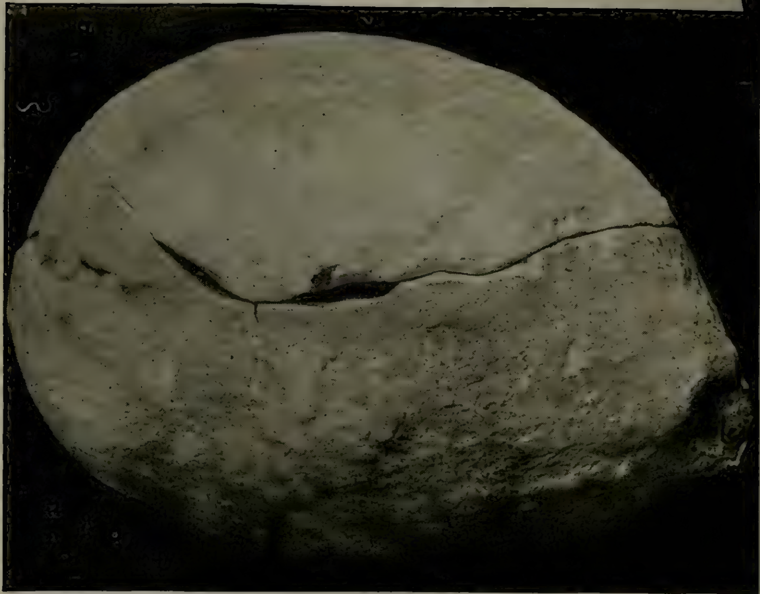
MR. DAWSON opened his subject by referring to the early mention, by Lord Bacon and Dr. Plot, of entombed toads. He also remarked that abundance of notices had appeared in *The Zoologist.* The best series of instances had been collected by Mr. P. H. Gosse, F.R.S., in his *Romance of Natural History* (second series).

Referring to the recent discovery of a specimen in Sussex, and then exhibited to this Society, Mr. Dawson said:— A mummied toad in the hollow flint nodule was discovered at Lewes by two workmen named Mr. Thomas Nye and Mr. Joseph Isted, about two summers ago.

The nodule was lying with others on the side of the road, to be used as road metal, and the flints had been obtained from a neighbouring quarry at the base of the Downs, to the North-East of Lewes. It was thickly covered with a crust of chalk, and attracted the attention of the men by its peculiar shape, being in form like a large citron (present size—length, 5½ inches; circumference, 12 inches; diameter, 4 1-8th inches).

The comparative lightness of the stone induced Mr. Nye to break it open, when, in a hollow in the centre, was discovered the mummied toad, encrusted with chalky matter, together with a loose mass of fine white chalk (with sponge-spicules), and "pith" (presumably portions of a fossil sponge).

The hole communicating with the cavity to be seen at the narrow or pointed end of the stone was not then opened, but was filled with silted chalk, which rendered it almost invisible, as will



Block kindly presented by *The Illustrated London News.* The photograph shows the two fractured portions of the nodule enclosing the toad replaced. The hole at the apex of the nodule is shown blocked up as originally discovered. The hole has now been cleared out and is about half-an-inch in diameter.

Block kindly presented by *The Illustrated London News.* The photograph shows the toad in the hollow flint as discovered on breaking open the nodule.

be seen in the photographs.* Mr. Nye carried the specimen home as a curiosity.

The same day that it was found, Dr. J. Burbidge, of Lewes, informs me it was brought to him. He obtained the loan of it for a considerable time, and Mrs. Burbidge took three small photographs of it. Dr. Burbidge says that he is acquainted with Mr. Nye, and has professionally attended his family for some years, and believes him to be honest and trustworthy. I have also carefully questioned both the men, who have given a consistent account of the discovery. From other enquiries I have found them to be of good report.

The rare and fortuitous nature of most of these discoveries renders the probabilities so much in favour of their being made by unscientific persons, that we must, perforce, receive with caution, but with respect, the only *possible* evidence, where it proves to be reasonable and consistent.

Unfortunately, while on loan, the smaller piece of the flint, now forming the lid of the cavity, was again accidentally fractured, while in the possession of Dr. Burbidge, and was cemented again by him. The specimen was returned to Mr. Nye, who refused to part with it, and was somewhat annoyed at its breakage, declining to trust it elsewhere.

The late Mr. C. T. Phillips, Curator of the Castle Museum, Lewes, entered into negotiation with Mr. Nye for its purchase, but, owing to the sudden death of the former gentleman, the matter dropped, although Mr. Nye had, at that time, entertained the question of parting with it to a local Museum, in preference to selling it privately.

My attention was first drawn to the matter, soon after the discovery, by Mr. John Lewis, C. E, F.S.A., who shewed me the three small photographs of the specimen, which had been given to him by a friend at Lewes, but he told me that he had not seen the specimen itself. On seeing the photographs, and not being able to detect any trace of organic structure, I regarded the toad-like object in the flint as merely bearing an accidental, though striking, resemblance to a toad. Mr. Lewis gave me the photographs, which I kept, regarding the object in the hollow of the flint as being an example of the curious imitative resemblances flint stones often assume. The same *a priori* conclusion has been come to by every geologist of repute who has yet, *alone*, seen the photographs.

It was not until March of the present year that, on turning over some photographs, I again by chance came upon these three photographs, and as I thought the specimen itself would be interesting to possess, I commenced to make inquiries as to its whereabouts. After considerable trouble, I found it still in the

* I have photographed the hole in its original condition.

possession of Mr. Nye. I then discovered to my surprise that the object in the flint was a mummied or desiccated toad covered with a slight deposit of chalky matter.

I purchased the specimen from Mr. Nye on the understanding that it should be presented to the Brighton Museum (Mr. Henry Willett's Collection), and that his name should be associated with its discovery.

The mummied body of the toad, which is $2\frac{1}{2}$ inches long, appears to fit in with certain irregularities in the floor of the cavity, the skin having probably sunk into them during the time when the body was drying.

I find, on examination of the nodule, that the hollow had probably once been occupied by a sponge around which the flint had formed. The sponge had decayed leaving a cavity within the flint, and the decay of its stem had left a round hole at the lower or pointed end of the stone. I found on piercing the hole that it was filled only with chalk (diameter of hole half an inch). Through this hole the animal when small must have crawled into the cavity. A day must soon have come when the toad could no longer get out, and it could only have subsisted upon such insects and other small organisms as came within reach of its tongue. How long it remained there cannot be estimated, but it probably did not long survive the silting up of the hole.

Experiments have shown that the growth of these animals is greatly accelerated by abundance of food and retarded by want of it. Indeed, it seems that under certain conditions they may even shrink in size; but without food there can be no real increase in substance. The amount of food reaching the toad also cannot be estimated; much would depend on the situation of the stone when the animal was entombed. Supposing, for instance, that the nodule was protruding from its bed in the chalk at the bottom of a long crevice, down which the toad had fallen, the supply of insects would have been very small.

On the other hand, it may have been then situate on the surface, in the vicinity of some decaying or other matter which might have attracted insects and other organisms to the vicinity of the orifice of the nodule.

There is another problem to which I should like to draw the attention of naturalists, viz.: as to whether the fetid and acrid exudations from the skin of toads may not attract flies, insects, and other organisms towards these creatures, so as to cause them to come within range of their long, elastic tongues?

Again, a toad has a peculiar method of softly scratching the ground with its hind claws when preparing to strike its prey; which noise or vibration may, perhaps, be a cause of attraction to certain insects. Such factors as these, or the mere perception of the presence of moisture by insects, &c., may have induced them to enter the hole in this nodule (or in other cases the

crevices in which toads are found entombed), and in such quantities that the animal might exist and grow.

Dr. Buckland's interesting experiments (1825-1827) with imprisoned toads were entirely directed against the well known theories that entombed toads had existed from the Geological era, when the matrix which enclosed them was supposed to have formed around them.

It is useless now to discuss this question, because every reasonable person now realizes the absurdity of the supposition of a living toad becoming the nucleus of a flint nodule at the bottom of the ocean, or being preserved alive in hollows in the Coal Measures (from the time of their original formation), where all associated remains show evidence of the enormous pressure to which they have been subjected.

Dr. Buckland's experiments are, however, very interesting, and an abstract of his records are here given.

" On the curious question, whether toads live, as reported, in holes in stones, Dr. Buckland, of Oxford, has published an account of some rather cruel experiments, namely:

On the 26th of November, 1825, he placed one live toad in each of twenty-four cells, twelve in coarse, and twelve in compact siliceous limestone, with a double cover of glass and slate placed over each of them, and cemented down by the luting of clay.

The weight of each toad, in grains, was ascertained, and the large and small ones were distributed in equal proportion between the limestone and the sandstone cells.

These blocks of stone were then buried together beneath three feet of earth, and remained unopened until the 10th of December, 1826.

Every toad in the smaller cells of the *compact* sandstone was dead, and the bodies of most of them so much decayed that they must have been dead some months.

The greater number of those in the larger cells of *porous* limestone were alive. No. 1, whose weight when immured was 924 grains, now weighed only 698 grains.

No. 5, whose weight when immured was 1,185 grains, now weighed 1,265 grains. The glass cover over this cell was slightly cracked, so that minute insects might have entered; none, however, were discovered in this cell.

But in another cell, whose glass was broken, and the animal within it dead, there was a large assemblage of minute insects, and a similar assemblage also on the *outside* of the glass of a third cell.

In No. 9, a toad, which weighed 988 grains, had increased to 1,116 grains, and the glass cover over it was entire. No. 11, had decreased from 936 grains to 652.

Before the expiration of a second year, all the large ones also were dead.

These were examined several times during the second year through the glass covers of the cells, but without removing them to admit air. They appeared always awake with their eyes open, and never in a state of torpor, their meagreness increasing at each interval in which they were examined, until at length they were found dead.

Those two also which had gained an accession of weight at the end of the first year, and were then carefully closed up again were emaciated and dead before the end of the second year.

At the same time that these toads were enclosed in stone, *four other toads* of middling size were enclosed in three holes cut on the North side of the trunk of an apple-tree, two being placed in the largest cell, and each of the others in a single cell. The cells were nearly circular, about five inches deep, and three inches in diameter. They were carefully closed up with a plug of wood, so as to exclude access of insects, and, apparently, were air-tight. When examined at the end of a year, every one of the toads was dead, and their bodies decayed.

And besides the toads enclosed in stone and in wood, *four others* were placed each in a small basin of Plaster of Paris, four inches deep and five inches in diameter, having a cover of the same material carefully 'luted' round with clay. These were buried at the same time, and at the same place, with the blocks of stone, and on being examined at the same time with them in December, 1826, two of the toads were dead, the other two alive."

Dr. Townson recorded a series of observations which he made on tame frogs, and also on some toads; these were directed chiefly to the very absorbent power of the skin of these animals. and show that they take in and reject liquids, through their skin alone, by a rapid process of absorption and evaporation, a frog absorbing sometimes in half an hour as much as half its own weight, and in a few hours the whole of its own weight of water, and nearly as rapidly giving it off when placed in any position that is warm and removed from moisture. Dr. Townson contended that as the frog tribe never drink water, this fluid must be supplied by means of absorption through the skin. Both frogs and toads have a large bladder, which is often full of water: "Whatever this fluid may be," he says, "it is as pure as distilled water and equally tasteless; this I assert, as well of that of the toad which I have often tasted, as that of frogs." Dr. Townson found both frogs and toads perfectly harmless and innoxious.

When specimens of entombed toads and frogs have been discovered from time to time by unscientific people, the finders usually preserve only either the toad or the stone in which it is reported to have been found.

I am not aware that any complete specimen *in situ* has ever before been brought to scientific observation.

To summarise the whole question of these reported discoveries

I think we may infer that the stories of toads being found alive in rocks and in the hearts of trees arise from the following circumstances:—Toads when small will often creep into holes in rocks and hollows in trees, and in these situations they may find sufficient food; being slothful in their habits, and capable of existing upon but little food, and of abstaining from it for a long time, they are apt to remain in their snug quarters and content themselves with what insects, &c., may come to them. In this way they may grow too large to get out of the hole, and live for a great time in it; when chance discovers them, by the rock being broken open or the wood of the tree cleft, the opening into which they had crept, and which may have been subsequently closed, is then entirely overlooked.

WEDNESDAY, JUNE 19TH, 1901.

Roger Bacon:

A CHAPTER IN THE HISTORY OF SCIENCE IN THE 13th CENTURY.

R. J. RYLE, M.D.

THE 13th Century has been called a precocious age. It was the age of Simon de Montfort, the pioneer of English statesmanship. It was the age of Dante. It was the age of Thomas Aquinas and Duns Scotus. Roger Bacon deserves to be remembered among the great ones of this period, for he was among the first to advocate the claims of the Sciences at a time when nearly all around were either indifferent or actively hostile.

He was born of good family in the year 1213, and he studied both in Oxford and at Paris. Somewhat early in his career he joined the Franciscan Order, being led to take this step (in all probability) by the fact that the students of this Order were at this time enjoying the great advantage of the direct teaching of Robert Grossteste, afterward Bishop of Lincoln.

The works of Roger Bacon which we have had the following origin: About the year 1264 Pope Urban VI. had sent one of his cardinals to England. This Cardinal became acquainted with Roger Bacon. A few years later this Cardinal himself became Pope, with the title of Clement IV., and soon after his elevation to the Papacy he wrote to Roger Bacon and requested copies of his writings.

Although at that time the learned friar seems to have published nothing, he began immediately to write, and within 18 months he had produced the "Opus Majus," the "Opus Minus," and the "Opus Tertium." The first of these works is the one by which he is chiefly known.

It is an eloquent exposition of the claims of genuine learning, and it is at the same time an appeal for reformation in the modes which were then current for the building up of knowledge. It is an appeal for the study at first hand of Greek and Hebrew writings, the wisdom contained in which was at that time only delivered to the student in the form of very meagre summaries and commentaries, many of which were themselves based not

upon the originals but upon Arabic versions. It is also an appeal for the cultivation of mathematics and for the freer use of observation and experiment. Lastly, it is an exposition, in clear and vivid, if not always classical, Latin, of certain leading branches of Science which Bacon had studied himself. Whewell has spoken of the work as at once the Encyclopædia and the Novum Organon of the 13th Century. It makes no pretensions to the teaching of any systematic doctrine as to the philosophy or logic of Induction, nor did Roger Bacon attempt the sort of reformation which at the time of Galileo had developed into organized revolt against the teaching of Aristotle, and the authority of the Church as touching matters of Science. Nor does the work contain record of original discoveries. Ptolemy and the Arabian Alhazen were the sources of the greater part at least of Bacon's physical and astronomical learning.

It is not likely that he invented gunpowder, for it seems to have been known before his day. The use of magnifying glasses, too, was known before his time, and the claim made for him by Draper in his "History of the Intellectual Development of Europe" that he described the true theory of the telescope is extravagant, and seems to be based on a very vague statement in one of Roger Bacon's works to the effect that by means of optical contrivances distant things could be made to look as if they were near, and things low down may be made to appear high up, and so on.

The first part of his great work deals with the four chief causes of human ignorance. These are: (1) The influence of weak and unworthy authority. (2) The influence of custom. (3) The influence of the opinion of the ignorant multitude. (4) The desire to conceal ignorance under an ostentatious display of learning.

These four causes of human ignorance he describes as being stumbling blocks in the way of wisdom, and as being the source of all the ills which befall the human race.

The second division of the Opus Majus is devoted to proving that Theology is the one Science which is the mistress of all others, and that all learning originally was conveyed in the form of supernatural wisdom to the descendants of Noah. There is one perfect wisdom, which is contained in the sacred Scriptures.

The third division of the work discusses the utility of grammar. It is a vigorous defence of the value of knowledge of languages. The late Professor Max Muller gives this treatise the credit of being in its way a sort of attempt at an introduction to the Science of Philology.

The fourth part of the book is the one upon which the author chiefly prided himself. It is an exposition of what Roger Bacon calls Mathematics, and under this term is included what was then known of Geometry, Astronomy, Mechanics, and Geometrical Optics. It is in this work that we find the celebrated

appeal made by Roger Bacon to the Pope for the rectification of the Julian Calendar, which rectification was in fact not accomplished, so far as the country of Roger Bacon is concerned, till 1751. Mathematics, he tells us, hold the keys of all the Sciences. A large part of the treatise deals with the geometrical data of optics. A good and complete description is given of the anatomy of the eye, although he seems to have missed the optical function of the crystalline lens. Atmospheric refraction is described (after Alhazen) and the opinion is expressed that the moon and stars shine by means of a kind of phosphorescence induced by exposure to sunlight.

A whole book is devoted by Roger Bacon to an exposition of what he calls "Scientia Experimentalis." By this phrase he means knowledge due to direct apprehension or experience, as contrasted with knowledge which is the result of processes of reasoning.

In illustration of the merits of the method of experience we have a full and interesting study of the rainbow. The account given of it is, of course, very inadequate, as, indeed, any account, previous to Newton's discovery of the different refrangibilities of the components of white light, must be.

Nevertheless, it contains some capital bits of inductive study.

"Let the experimenter (he says) take hexagonal stones from Ireland or India which are called Frides (probably quartz crystals) and let him hold them in a ray of sunlight coming through a window. He will find all the colours of the rainbow projected upon any opaque object held behind it, and arranged in the order in which they occur in the rainbow. . . Then let him observe men rowing, and watch the drops as they fall from the oars. It is the same with the drops which fall from a water mill, and if on a summer morning a man will look at the dew drops which cling to the grass in a garden or a field he will still find the same colours." Further on he gives some less satisfactory examples of *Scientia Experimentalis* as bearing upon the problem of preventing old age. He tells us, for instance, of a pot of excellent ointment which a man anointed himself withal and lived in consequence without decay for many hundreds of years. But by an unlucky oversight the fortunate possessor of the excellent ointment had forgotten to anoint the soles of his feet. Accordingly they were not preserved from decay, "and so it was that the man was always seen on horseback."

The question of the relation of the later Bacon,—the Lord Verulam of the Novum Organon,—to the earlier Roger Bacon is of interest. The four stumbling blocks in the way of wisdom, already mentioned as occurring near the beginning of the Opus Majus, have been compared with the four "Idola" of Francis Bacon; but their superficial resemblance becomes less striking

on closer examination. Certain words, also, such as the adjective *prærogativus*, are common to both writers. And there was much in common in the aims of the two men. Both had great faith in progress. Both recognised the close bond of alliance which unites the several sciences. Both teachers insisted on the importance of a closer study of Nature by observation and experiment. But the resemblances are much greater in the general spirit of the two than they are when their writings are closely compared. Francis Bacon recognised and taught emphatically the evils of mixing theology with science. Roger Bacon continually insists on the theological form of the argument from final causes, and makes constant appeal to Scriptural and patristic literature in proof of physical facts. Had Francis Bacon been acquainted with the Opus Majus, the frequent examples of this form of unscientific method which occur therein would almost certainly have elicited some note of censure. Roger Bacon strove by teaching and by practice to set men on to the investigation of Nature by Induction, but he never attempted to formulate the rules of its employment, or to distinguish the processes by which general laws of Nature are arrived at through successive generalisations from the data of observation. Francis Bacon, on the other hand, did aim at doing for the philosophy of discovery what had been already done by Aristotle for the philosophy of argument. In this respect no amount of credit which Roger Bacon may deservedly receive for his work can impair the reputation of the author of the Novum Organon. The distinctive doctrines of the Novum Organon were not borrowed from the work of Roger Bacon, because they were not there to borrow.

There is, however, no doubt that if we compare the two Bacons as men of Science, we must rank the old friar above the Lord Chancellor. While Francis Bacon does not shew a close personal acquaintance with the sciences of his day, Roger Bacon on the other hand was evidently himself a thoroughly trained scientific worker, familiar with the use of astronomical apparatus and of astronomical and other numerical data.

We may keep a niche in the Temple of Science for the figure of the old friar who was the first in the line of modern physicists, and although his own generation rejected him we may recognise his voice across the intervening centuries as that of a true herald of the present age of Science.

WEDNESDAY, JUNE 12TH, 1901.

Annual General Meeting.

REPORT OF THE COUNCIL

FOR THE YEAR ENDING JUNE 12TH, 1901.

There is little of any special importance in the annals of the Society to record during the past year. The Lecture entitled "Autocrats and Fairies," given by Mr. Enock, to which the public were admitted on payment, resulted in so small a loss that it will probably be in the interests of the Society to repeat the experiment. In order to obtain records of facts and phenomena of interest, and which may be of importance from a Natural History point of view,—such as the date of the appearance and disappearance of certain birds and insects, or the scarcity or abnormal abundance of them at different seasons, &c.,—notice has been sent to all Members that Mr. W. W. Mitchell, of 66, London Road, has kindly offered to take charge of a book in which such observations as may be sent to him by Members will be entered.

As other Societies are adopting the same course, it is to be hoped that Members generally may take an interest in the scheme, so that the results obtained in different districts will admit of comparison.

During the past year fourteen new Members have been enrolled, eleven have resigned, one has died, and five have been struck off the list.

The Excursions have been as follows :—

1900.	May 12th.	Friar's Oak and Danny Park.
,,	June 21st.	Maresfield.
1901.	May 14th.	Shoreham and Steyning.

Papers read before the Society at its Ordinary Meetings :—

1900. Oct. 10th. "The Amateur in Science."—
Mr. W. CLARKSON WALLIS.

,, Nov. 13th. "The Ancient Beaches of Brighton and their Microscopical Contents."—
Mr. FRED. CHAPMAN, A.L.S., F.R.M.S.

1900. Dec. 12th. "Evening for Exhibition of Specimens—Microscopic and others."

1901. Jan. 25th. "Among the Books."—Mr. H. DAVEY, Jun.

„ Feb. 13th. "How Electricity is Measured."—Mr. E. PAYNE, M.A.

„ Mar. 13th. "The Pottery of Pre-historic and Roman Britain."—Mr. H. S. TOMS.

„ Mar. 27th. "Natural Colour Photography."—Mr. D. E. CAUSH and Mr. J. WILLIAMSON.

„ April 26th. "Discovery of Toad in Interior of Flint."—Mr. C. DAWSON, F.S.A., F.G.S.

„ May 16th. "Friar Bacon: A Chapter in the History of Science in the 13th Century."—Dr. R. J. RYLE.

„ June 12th. Annual General Meeting.

In addition to these there has also been the following Lecture to which the public were admitted on payment:—

1901. Feb. 26th. "Autocrats and Fairies."—Mr. FRED. ENOCK.

LIBRARIAN'S REPORT.

Although 120 books and serials have been lent out during the past year, showing a slight increase, yet only a few of the Members make use of the Society's Library.

The splendid collection of 328 volumes, presented to the Society last year by Mr. J. E. Haselwood, includes a number of books of which the Society already contained copies; it has therefore been decided that duplicates shall be valued and offered to Members for Sale.

The publications of the Smithsonian Institution, received by exchange, have this year included Part 1 of an important Monograph on the American Hydroids, and Part 4 of the Fishes of Northern and Central America.

The 9th and last volume of Buckler's monumental work on the Larvæ of British Lepidoptera, published by the Ray Society, has been received.

H. DAVEY, JUNR.,
Hon. Librarian.

METEOROLOGICAL REPORT.

In the Table printed on the opposite page the main meteorological features of the twelve months—July, 1900, to June, 1901, —are contrasted with the averages of the corresponding records for the years 1877 to 1900.

The rainfall was very much below the average, the amount in September being only a quarter of the average amount for the years 1877 to 1900. In the first week in August, 1900, a considerable amount of rain fell, culminating in a fall of 0·42 inches on Bank Holiday, August 6th. The lowering of the temperature, and the cleansing of the streets caused by this rainfall, led to a considerable reduction in the usual autumnal mortality from epidemic diarrhœa, the amount of this troublesome infantile complaint being much less in 1900 than in preceding years.

The accompanying Table, dealing with the years (January to December) 1877 to 1900, shows that we have been passing through a cycle of dry years which still continues. The accumulated deficiency of rainfall since 1886 has been 35·71 inches.

Since the beginning of March, 1899, a record of rainfall has been kept on my behalf by Mr. Mitchell, the Head Master of Pyecombe School. The differences between this record and that of Brighton are shown in the following table :—

	Pyecombe.		Brighton.
1899 (March to December) ...	22·73	...	18·00
1900	35·83	...	27·63
1901 (January to June) ...	11·52	...	7·52
	70·08		53·35

Thus, during the period of 28 months, 16·73 more inches of rain fell at Pyecombe than in the Old Steine, Brighton.

Deviation from Average Rainfall (29·13 inches) of 24 years, 1877-1900.

Year.		Deficiency.		Excess.		Accumulated Deficiency.
1887	...	7·03	...	—	...	7·03
1888	...	0·97	...	—	...	8·00
1889	...	1·68	...	—	...	9·68
1890	...	5·52	...	—	...	15·20
1891	...	—	...	5·25	...	9·95
1892	...	2·66	...	—	..	12·61
1893	..	5·00	...	—	...	17·61
1894	...	—	...	2·82	..	14·79
1895	...	3·94	...	—	...	18·73
1896	...	1·29	...	—	...	20·02
1897	...	0·01	...	—	...	20·03
1898	...	8·72	...	—	...	28·75
1899	...	5·66	...	—	...	34·41
1900	...	1·30	...	—	...	35·71

ARTHUR NEWSHOLME.

Month.		Temperature of Air during Month.			Relative Humidity. Saturation=100.	Wind. Number of Days of									Rainfall.		Sunshine.	
		Highest.	Lowest.	Mean.		N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.	Number of Days on which Rain fell	Amount collected in Inches.	Number of Sunless Days.	Number of Hours recorded.
July,	1900 ...	81·2	50·2	65·3	76	—	—	2	1	7	5	6	6	4	7	1·31	1	310·00
,,	1877-1900 ..	85·0	45·0	61·9	73										12	2·29	1	231·34
August,	1900 ...	81·4	50·4	62·5	73	1	7	1	—	1	7	5	8	1	16	2·31	3	235·41
,,	1877-1900 ..	89·4	44·3	62·1	75										13	2·40	1	218·22
September,	1900 ...	74·6	44·2	59·8	74	5	5	1	—	1	8	2	2	6	8	0·65	2	210·57
,,	1877-1900 .	83·2	35·9	58·3	79										12	2·56	2	175·11
October,	1900 ...	66·2	38·6	52·9	80	—	—	—	—	3	7	9	7	5	16	2·64	4	114·82
,,	1877-1900...	73·0	29·5	51·6	78										16	3·87	6	124·22
November,	1900 ...	59·6	32·0	48·6	88	2	3	—	—	4	6	6	1	8	26	3·62	8	57·34
,,	1877-1900...	63·5	17·9	46·3	86										16	3·37	10	70·55
December,	1900 ...	54·6	34·0	47·3	89	1	2	—	—	2	10	6	3	7	22	3·54	16	38·01
,,	1877-1900...	69·4	17·6	41·9	83										16	2·69	13	54·57
January,	1901 ...	53·4	23·6	40·6	87	4	2	2	1	4	5	5	4	4	13	0·89	9	74·75
,,	1877-1900...	63·6	12·0	39·6	86										16	2·71	12	58·16
February,	1901 ...	48·0	23·0	37·1	86	8	2	1	—	2	2	1	8	4	13	1·77	7	63·98
,,	1877-1900...	58·0	17·4	41·1	81										13	2·19	8	88·00
March,	1901 ...	53·4	25·8	41·3	82	6	14	1	—	—	7	3	—	—	15	1·37	7	93·50
,,	1877-1900...	65·0	20·2	42·4	81										13	1·79	4	139·11
April,	1901 ...	70·2	32·2	49·0	75	2	3	4	1	2	7	2	5	4	13	1·78	3	210·76
,,	1877-1900...	75·4	28·0	46·9	81										12	1·78	3	177·11
May,	1901 ...	72·2	38·2	54·5	72	1	18	1	—	—	1	1	6	3	5	0·69	1	274·25
,,	1877-1900...	78·1	30·0	53·0	73										11	1·65	2	235·52
June,	1901 ...	80·2	43·0	59·7	72	3	6	2	2	4	6	3	2	2	9	1·02	2	261·66
,,	1877-1900...	85·0	37·0	59·4	72										12	1·83	2	228·12
Entire Year		81·4	23·0	51·5	79	33	62	15	5	30	71	49	52	48	163	21·59	63	1945·05
Average of 1877-1900...		89·4	12·0	50·3	79										162	29·13	64	1803·03

Brighton and Hove Natural History and Philosophical Society.

TREASURER'S ACCOUNT FOR THE YEAR ENDING 12th JUNE, 1901.

Cr.

	£	s.	d.
To Balance in the hands of the Treasurer, 13th June, 1900	7	3	5
" Annual Subscriptions to 1st October, 1900 ...	18	0	0
" Annual Subscriptions to 1st October, 1901 ...	61	0	0
" Annual Subscriptions to 1st October, 1902 ...	0	10	0
" Entrance Fees	3	0	0
" Dividends on £100 2¾ per cent. Consols for one year	2	15	0
	£92	8	5
Balance brought over	20	11	2

NOTE.—There is a sum of £100 2¾ per cent. Consolidated Stock standing in the names of the Hon. Treasurer and Hon. Secretaries as Trustees for the Society.

Dr.

	£	s.	d.
By Books and Periodicals	7	3	2
" Bookbinding	0	17	9
" Printing Annual Report and Abstract of Proceedings	8	11	0
" Printing and Stationery (General)	6	9	9
" Postage, &c. (General)	9	4	6
" Scientific Secretary, Honorarium...	10	0	0
" Subscriptions to Societies	4	10	7
" Clerk's Salary	2	2	0
" Commission to Collector	3	0	0
" Gratuities to Museum Assistants	3	0	0
" Expenses of Meetings, Delegates to Meetings, Excursions, Hire of Rooms, Tea and Coffee, and Incidental Expenses	12	7	6
" Alteration and Inscription of Bookcase	3	10	0
" Fire Insurance Premium on Books	1	1	0
" Balance	20	11	2
	£92	8	5

HERBARIUM.

The following plants have been added since last Report :—

Fumaria confusa.	Uckfield.
Lepidium Smithii.	Telscombe.
Elatine hexandra.	Piltdown.
Rubus plicatus, var Bertramii.	Wiggenholt Common.
Caucalis latifolia.	Kingston-by-Sea.
Caucalis daucoides.	" "
Galium verum, b. ochroleucum.	Camber Sands.
Galium anglicum. Crepis fœtida.	Between Seaford and Alfriston.
Plantago lanceolata var. timbali.	Preston.
Chenopodium opulifolium.	Southwick.
Chenopodium rubrum, b. pseudo-botryoides.	
Malaxis paludosa.	
Iris fœtidissima.	Bramber.
Ruppia rostellata.	Lewes.
Eleocharis acicularis.	Amberley.
Carex strigosa.	Wannock Glen.
Panicum Crus-galli.	Southwick.

T. HILTON,
Curator.

RESOLUTIONS, &c., PASSED AT THE 48th ANNUAL GENERAL MEETING.

After the Reports and Treasurer's Account had been read, it was resolved—

> "That the Report of the Council, the Treasurer's statement (subject to its being audited and found correct), and the Librarian's Report be received, adopted, and printed for circulation as usual."

The Secretary reported that in pursuance of Rule 25 the Council had selected the following gentlemen to be Vice-Presidents of the Society for the ensuing year—

> "Mr. J. E. Haselwood, Dr. A. Newsholme, Mr. D. E. Caush, Mr. E. J. Petitfourt, B.A., F.C.P., Mr. J. P. Slingsby Roberts, Dr. E. McKellar, Deputy Surgeon General, J.P., Mr. A. G. Henriques, J.P., and Dr. W. J. Treutler."

And that in pursuance of Rule 42 the Council had appointed the following gentlemen to be Honorary Auditors—

> "Mr. J. W. Nias and Mr. S. Cowell."

It was proposed by Mr. E. PAYNE, seconded by Mr. J. H. GILKES, and resolved—

> "That the following gentlemen be Officers of the Society for the ensuing year :—*President:* Mr. W. C. Wallis ; *Ordinary Members of Council:* Mr. W. W. Mitchell, Mr. E. Payne, M.A., Mr. J. Lewis, F.S.A., C.E., Mr. F. R. Richardson, Dr. R. J. Ryle, Dr. E. Hobhouse ; *Honorary Treasurer:* Mr. E. A. T. Breed ; *Honorary Librarian:* Mr. H. Davey, Jun. ; *Honorary Curators:* Mr. H. S. Toms and Mr. T. Hilton ; *Honorary Secretaries:* Mr. Edward Alloway Pankhurst, 3, Clifton Road, and Mr. J. Colbatch Clark, 64, Middle Street ; *Assistant Honorary Secretary:* Mr. H. Cane."

It was proposed by Mr. J. W. NIAS, seconded by Mr. J H. GILKES, and resolved—

> "That the best thanks of the Society be given to Mr. W. Clarkson Wallis for his attention to the interests of the Society as its President during the past year."

It was proposed by Mr. T. HILTON, seconded by Mr. D. E. CAUSH, and resolved—

> "That the sincere thanks of the Society be given to the Vice-Presidents, the Council, the Honorary Librarian, the Honorary Treasurer, the Honorary Curator, the Honorary Auditor, and the Honorary Secretaries, for their services during the past year."

SOCIETIES ASSOCIATED,

WITH WHICH THE SOCIETY EXCHANGES PUBLICATIONS,

And whose Presidents and Secretaries are *ex-officio* Members of the Society :—

British Association, Burlington House, Piccadilly.
Barrow Naturalists' Field Club.
Belfast Naturalists' Field Club.
Belfast Natural History and Philosophical Society.
Boston Society of Natural Science (Mass., U.S.A.).
British and American Archæological Society, Rome.
Cardiff Naturalists' Society.
City of London Natural History Society.
Chester Society of Natural Science.
Chichester and West Sussex Natural History Society.
Croydon Microscopical and Natural History Club, Public Hall, Croydon.
City of London College of Science Society, White Street, Moorfields, E.C.
Department of the Interior, Washington, U.S.A.
Eastbourne Natural History Society.
Edinburgh Geological Society.
Epping Forest and County of Essex Naturalist Field Club, West Ham Institute.
Folkestone Natural History Society.
Geologists' Association.
Glasgow Natural History Society and Society of Field Naturalists.
Hampshire Field Club.
Huddersfield Naturalist Society.
Leeds Naturalist Club.
Lewes and East Sussex Natural History Society.
Maidstone and Mid-Kent Natural History Society.
North Staffordshire Naturalists' Field Club and Archæological Society.
Nottingham Naturalists' Society, Hazlemont, The Boulevard, Nottingham.
Peabody Academy of Science, Salem, Mass., U.S.A.
Quekett Microscopical Club.
Royal Microscopical Society.
Royal Society.
Smithsonian Institute, Washington, U.S.A.
South-Eastern Union of Scientific Societies.
South London Microscopical and Natural History Club.
Société Belge de Microscopie, Bruxelles.
Tunbridge Wells Natural History and Antiquarian Society.
Watford Natural History Society.
Yorkshire Philosophical Society.

LIST OF MEMBERS

OF THE

Brighton and Hove Natural History and Philosophical Society,

1901.

N.B.—Members are particularly requested to notify any Change of Address at once to Mr. J. C. Clark, 64, Middle Street, Brighton. When not otherwise stated in the following List the Address is in Brighton.

ORDINARY MEMBERS.

ABBEY, HENRY, Fair Lee Villa, Kemp Town.
ASHER, Rev. F., 33, Clifton Terrace.
ASHTON, C. S., 3, Chatsworth Road.
ATTREE, G. F., 8, Hanover Crescent.

BABER, E. C., M.B., L.R.C.P., 46, Brunswick Square.
BADCOCK, LEWIS C., M.D., M.R.C.S., 10, Buckingham Place.
BEVAN, BERTRAND.
BEVAN, A. S. B., Coolavin, Harrington Road.
BILLING, T., 86, King's Road.
BOOTH, E., 53, Old Steine.
BREED, E. A. T., 32, Grand Parade.
BROOKS, J. W., West Cott, Dorking.
BROWN, J. H., 6, Cambridge Road, Hove.
BROWN, GEORGE, Cottesmore, The Upper Drive.
BULL, W., 75, St. Aubyns, Hove.
BURROWS, W. S., B.A., M.R.C.S., 62, Old Steine.
BURCHELL, E., L.R.C.P., 5, Waterloo Place.

CANE, H., 173, Ditchling Road.
CATT, REGINALD J., 28, West Hill Street.
CAUSH, D. E., L.D.S., 63, Grand Parade.
CHARRINGTON, H. W., 23, Park Crescent.
CLARK, J. COLBATCH, 64, Middle Street.
COLMAN, Alderman J., J.P., 14, King's Gardens, Hove.
COUCHMAN, J. E., Down House, Hurst.

Cowell, S., 16, Alexandra Villas.
Cowley, E. R., 12, Stanford Avenue.
Cox, A. H., J.P., 35, Wellington Road.

Davey, Henry, J.P., 82, Grand Parade.
Davey, Henry, Junr., 82, Grand Parade.
Deedes, Rev. Canon, 2, Clifton Terrace.
Denman, S., 26, Queen's Road.
Dodd, A. H., M.R.C.S., L.R.C.P., 45, St. John's Terrace, Hove.
Draper, Dr., Municipal School of Technology.

Edmonds, H., B.Sc., Municipal School of Technology.
Elgee, E., Mountjoy, Preston Road.
Ewart, Sir J., M.D., F.R.C.P., M.R.C.S., F.Z.S., Bewcastle, Dyke Road.

Fletcher, W. H. B., J.P., Bersted Lodge, Bognor.

Gilkes, J. H., 6, Hanover Crescent.
Graves, A. F., 9A, North Street Quadrant.
Griffith, A., 59, Montpelier Road.
Grove, E., Norlington, Preston.

Hannah, I., The Vicarage.
Hack, D., Fircroft, Withdean.
Hardcastle, S. B., 71, East Street.
Harding, N., Wynnstay, Stanford Avenue.
Harrison, W., D.M.D., 6, Brunswick Place, Hove.
Haselwood, J. E., 3, Richmond Terrace.
Haynes, J. L., 24, Park Crescent.
Henriques, A. G., F.G.S., J.P., 9, Adelaide Crescent, Hove.
Hickley, G., 92, Springfield Road.
Hilton, T., 16, Kensington Place.
Hobbs, J., 62, North Street.
Hobhouse, E., M.D., 36, Brunswick Place, Hove.
Holder, J. J., 8, Lorne Villas.
Horniman, F. J., M.P.
Horton, W. T., 42, Stanford Road.
Howlett, J. W., 4, Brunswick Place, Hove.

Infield, H. J., Sylvan Lodge, Upper Lewes Road.

Jacomb, Wykeham, 72, Dyke Road.
Jenner, J. H. A., Lewes.
Jennings, A. O., LL.B., 11, Adelaide Crescent, Hove.
Jennings, A. S., 21, Chesham Terrace.
Johnston, J., 12, Bond Street.
Jones, J. J., 49, Cobden Road.

Knight, J. J., 33, Duke Street.

Langton, H., M.R.C.S., 11, Marlborough Place.
Law, J., Crosthwaite, Lewes.
Lewis, J., C.E., F.S.A., Fairholme, Maresfield.
Lewis, J., 37, Preston Road.
Loader, Kenneth, 5, Richmond Terrace.

McKellar, E., Deputy-Surgeon-General, M.D., J.P., Woodleigh, Preston.
Maguire, E. C., M.D., 41, Grand Parade.
May, F. J. C., 25, Compton Avenue.
Merrifield, F., 24, Vernon Terrace.
Mills, J., 24, North Road.
Mitchell, W. W., 66, Preston Road.
Morgan, G., L.R.C.P., M.R.C.S., 6, Pavilion Parade.
Muston, S. H., 54, Western Road.
McPherson, T., 4, Bloomsbury Place.

Newmarch, Major-General, 6, Norfolk Terrace.
Newsholme, A., M.D., M.R C.P., 11, Gloucester Place.
Nias, J. W., 65, Freshfield Road.
Nicholson, W. E., F.E.S., Lewes.
Norman, S. H., Burgess Hill.
Norris, E. L., 8, Cambridge Road, Hove.

Pankhurst, E. A., 3, Clifton Road.
Paris, G. De, 55, Brunswick Place.
Payne, W. H., 6, Springfield Road.
Payne, E., Hatchlands, Cuckfield.
Penney, S. R., Larkbarrow, Dyke Road Drive.
Perry, Aylett W., Annesley Hall, Dyke Road.
Petitfourt, E. J., B.A., F.C.P., 16, Chesham Street.
Pugh, Rev. C., 13, Eaton Place.
Puttick, W., Brackenfell, Hassocks.
Pownall, R. B., 58, Regency Square.

Read, S., 12, Old Steine.
Richardson, F. R., 10, Vernon Terrace.
Roberts, J. P. Slingsby, 3, Powis Villas.
Robinson, E., Saddlescombe.
Rose, T., Clarence Hotel, North Street.
Ross, D. M., M.B., M.R.C.S., 9, Pavilion Parade.
Ross, Surgeon-General D. R., M.D., 19, Park Crescent.
Ryle, R. J., M.D., 15, German Place.

Salmon, E. F., 30, Western Road, Hove.
Savage, W. W., 109, St. James's Street.
Sloman, F., 18, Montpelier Road.
Scott, E. Irwin, M.D., 69, Church Road, Hove.
Smith, C., 47, Old Steine.
Smith, T., 1, Powis Villas.

SMITH, W., 6, Powis Grove.
SMITH, W. J., J.P., 42 and 43, North Street.
SMITH, W. H., 191, Eastern Road.
STEPHENS, W. J., L.R.C.P., 9, Old Steine.
STONER, HAROLD, L.D.S., M.R.C.S., L.R.C.P., 18, Regency Square.

TALBOT, HUGO, 78, Montpelier Road.
THOMAS, J., Kingston-on-Sea.
TREUTLER, W. J., M.D., F.L.S., 8, Goldstone Villas, Hove.
TOMS, H. S., The Museum.

WALLIS, C., Sunnyside, Upper Lewes Road.
WALLIS, W. CLARKSON, 15, Market Street.
WALTER, J., 13A, Dyke Road.
WELLS, I., 4, North Street.
WHYTOCK, E., 36, Western Road.
WIGHTMAN, G. J., Wallands Park, Lewes.
WILKINSON, T., 170, North Street.
WILLETT, H., F.G.S., Arnold House, Montpelier Terrace.
WILLIAMS, A. S., 17, Middle Street.
WILLIAMS, H. M., LL.B., 17, Middle Street.
WINTER, J. N., M.R.C.S., 28, Montpelier Road.
WOOD, F., 12, Lewes Crescent.
WOOD, J., 21, Old Steine.
WOODRUFF, G. B., 24, Second Avenue, Hove.
WRIGHT, A., 26, Park Crescent.

LADY MEMBERS.

BAGLEY, Miss, 38, Medina Villas, Hove.
BRINTON, Mrs. H., 40, King's Road.

CAMERON, Miss E., 25, Victoria Street.
CAUSH, Mrs., 63, Grand Parade.
CRAFER, Mrs. M. H., 6, Dyke Road.

FARGUS, Mrs., 7, Park Crescent.

GRAHAM, Miss, 42, Tisbury Road, Hove.

HARE, Miss, 19, Goldsmid Road.
HERRING, Miss, 38, Medina Villas, Hove.

LOVELOCK, Mrs., Coolavin, Harrington Road.

MORGAN, Miss, 39, St. Aubyns, Hove.
MCPHERSON, Mrs., 4, Bloomsbury Place.

NICHOLSON, Mrs., 9, Park Crescent.

Rich, Miss, Iken House, Roedean School.
Ross, Mrs., 19, Park Crescent.
Ruge, Miss, 7, Park Crescent.

Salmon, Mrs., 7, Clifton Road.
Skevington, Miss, 41, Buckingham Place.
Stoner, Mrs. H., 18, Regency Square.

Visick, Miss B., St. John's, Withdean.

Wallis, Mrs., Sunnyside, Upper Lewes Road.
Webb, Miss A. H., 54, Tisbury Road, Hove.
Wilkinson, Mrs., 30, Brunswick Place, Hove.
Wood, Mrs. J., 21, Old Steine.

HONORARY MEMBERS.

Arnold, Rev. F. H., The Hermitage, Emsworth.
Bloomfield, Rev. E. N., Guestling Rectory, Hastings.
Curteis, T., 244, High Holborn, London.
Dawson, C., F.G.S., Uckfield.
Farr, E. H., Uckfield.
Mitten, W., Hurstpierpoint.
Nourse, W. E. C., Norfolk Lodge, Thurlow Road, Torquay.
Phillips, Barclay, 7, Harpur Place, Bedford.
Lomax, Benjamin, The Museum, Brighton.